UNIVERSITY OF WYOMING.

Agricultural College Department.

WYOMING EXPERIMENT STATION,

LARAMIE, WYOMING.

INDEX BULLETIN A.

JULY, 1896.

Indexing the First Twenty-Six Bulletins of the Station.

BY THE SECRETARY.

Bulletins will be sent free upon request. Address: Director Experiment Station, Laramie, Wyo.

WYOMING

Agricultural Experiment Station.

UNIVERSITY OF WYOMING.

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LIST OF BULLETINS AND ANNUAL REPORTS BY THE AGRICULTURAL EXPERIMENT STATION, LARAMIE, WYO., MAY 1, 1891, TO DEC. 31, 1895, BULLETINS NOS. 1 TO 26, AND REPORTS NOS. 1 TO 5, INCLUSIVE.

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* " No. 2—August, 1891. Plant Lice. F. J. Niswander, Entomologist.

* " No. 3—November, 1891. The Sugar Beet in Wyoming. D. McLaren, Agriculturist, and E. E. Slosson, Chemist.

* " No. 4—December, 1891. Meteorology for 1891. B. C. Buffum, Meteorologist.

FIRST ANNUAL REPORT, 1891.

General Statement Regarding Station Work, with Bulletins Nos. 1 to 4, inclusive. D. McLaren, Director.

BULLETIN No. 5—February, 1892 Best Varieties and Breeds for Wyoming. D. McLaren, Agriculturist, and B. C. Buffum, Horticulturist.

† " No. 6—May, 1892. Soils of the Agricultural Experiment Farms. Relation of Geology and the Chemistry of Soils to Agriculture; J. D. Conley, Geologist. Analysis of the Soils of Wyoming Experiment Station Farms; E. E. Slosson, Chemist.

" No. 7—July, 1892. Insecticides. F. J. Niswander, Entomologist.

† " No. 8—October, 1892. Irrigation and Duty of Water. B. C. Buffum, Horticulturist.

†BULLETIN No. 9—December, 1892. Sugar Beets in Wyoming in 1892. E. E. Slosson, Chemist.

" No. 10—December, 1892. Meteorology of Wyoming in 1892. B. C. Buffum, Meteorologist.

†SECOND ANNUAL REPORT, 1892.

General Statements, with Bulletins Nos. 5 to 10. A. A. Johnson, Director.

BULLETIN No. 11—February, 1893. Crop Report for 1892. A. A. Johnson, Director, and F. J. Niswander, Superintendent Laramie Farm.

" No. 12—April, 1893. Ground Squirrels (Gophers). F. J. Niswander, Entomologist.

† " No. 13—July, 1893. The Feeding and Management of Cattle. W. A. Henry, Ph. D., University of Wisconsin. (Reprint by permission).

" No. 14—October, 1893. Geology of the Wyoming Experiment Farms, and Notes on the Mineral Resources of the State. W. C. Knight, Geologist.

" No. 15—December, 1893. The Winter-Killing of Trees and Shrubs. Aven Nelson, Botanist.

" No. 16—December, 1893. Grasses and Forage Plants. B. C. Buffum, Horticulturist.

†THIRD ANNUAL REPORT, 1893.

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BULLETIN No, 17—March, 1894. I. Crop Report for 1893. II. Cost and Profit of Growing Wheat. III. Sugar Beets. IV. Garden Vegetables and Tobacco. V. Meteorology for 1893. B. C. Buffum, Horticulturist, and E. E. Slosson, Chemist.

" No. 18—June, 1894. I. Reclamation of Arid Lands. II. The Harvey Water Motor. A. A. Johnson, Director.

" No. 19—September, 1894. Squirrel-Tail Grass (Fox-Tail); One of the Stock Pests of Wyoming. Aven Nelson, Botanist.

" No. 20—October, 1894. The Artesian Wells of Southern Wyoming. J. D. Conley, Physicist.

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" No. 23—May, 1895. Notes on Climate. J. D. Conley, Meteorologist.

" No. 24—August, 1895. Water Analyses. E. E Slosson, Chemist.

" No. 25—November, 1895. Results of Three Years' Experiments in Cost and Profit of Growing Wheat. B. C. Buffum, Agriculturist.

" No. 26—December, 1895. Garden Peas. B. C. Buffum, Agriculturist and Horticulturist.

FIFTH ANNUAL REPORT, 1895.

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*Out of print.
†Supply limited.

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UNIVERSITY OF WYOMING.

Agricultural College Department.

WYOMING EXPERIMENT STATION,

LARAMIE, WYOMING.

BULLETIN NO. 1.

MAY, 1891.

The Organization and the Proposed Work of the Station.

The Bulletins and Annual Reports of this Station will be sent the residents of this State upon request.

WYOMING
Agricultural Experiment Station.

UNIVERSITY OF WYOMING.

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Wheatland Experiment Farm,	Martin R. Johnston, Sup't

Wyoming University Experiment Farm,	The Director in charge
Laramie Experiment Garden,	Lawrence Fee, foreman
Laramie Tree Experiments,	The Horticulturist in charge
Laramie [U. S.] Experiment Grass Fields,	The Director in charge

THE ORGANIZATION OF THE WYOMING EXPERIMENT STATION AND ITS EXPERIMENT FARMS.

REPORT OF THE DIRECTOR.

The United States of America, by an Act of Congress, passed March 2, 1887, gave to every State and Territory having an agricultural college $15,000 annually for researches by said college. By an Act of the Legislature of the State of Wyoming, approved January 10, 1891, the Agricultural Department of the University of Wyoming was authorized to receive the above appropriation. March 27, 1891, the Trustees of the University elected to the position of Director of the Wyoming Experiment Station, Dice McLaren, M. S., Professor of Agriculture in the University of Wyoming, formerly Professor of Natural History in the Maryland Agricultural College.

By the terms of the Act of Congress, the text of which will be found on page 23 of this Bulletin, the purposes of the Experiment Stations are "to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture and to promote scientific investigation and experiment respecting the principles and applications of agricultural science." The act further states:

SEC. 2. That it shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at different stages of growth; the comparative advantages of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manure, natural or artificial, with ex-

periments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese, and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories.

The last clause authorizes the Wyoming Experiment Station to adapt the various lines of research to the high altitude and arid climate of this State. Hence methods of irrigation, means of retaining the moisture in the soil and varieties of grass suitable for the non-irrigated lands will receive special attention. The culture of the sugar beet, the adaptation of varieties to our mountain climate and many other experiments which promise to benefit our agricultural and grazing interests will form an essential part of the station work. Some of these experiments are described in the accompanying reports of the Station officers.

That the possibilities of agriculture in all parts and altitudes of Wyoming may be fairly tested, the Trustees have established experiment farms in various portions of the State. The west-central portion and the altitude of 5,500 feet above sea level is represented by the Lander Experiment Farm of 137 acres under irrigation in Fremont County and donated by its citizens. The Laramie Plains and the altitude of 7,000 feet is represented by the Wyoming University Experiment Farm of 640 acres in Albany County, irrigated from the Pioneer Canal, and granted by the Wyoming Central Land and Improvement Company. The North Platte Valley and the altitude of 6,000 feet is represented by the Saratoga Experiment Farm of 40 acres, under the Hugus-Mullison-Beale Ditch and the Davis-Folsom Canal in Carbon County, donated

by the Saratoga Improvement Company and the Saratoga Land and Irrigation Company. The northern part of the State and the altitude of 4,000 feet is represented by the Sheridan Experiment Farm of 50 acres, under irrigation, in Sheridan County, and donated by its citizens. North-eastern Wyoming, with the greatest rain-fall and the altitude of 4,500 feet, is represented by the Sundance Experiment Farm of 49 acres, to be carried on without irrigation, in Crook County, and donated by its citizens. Southeastern Wyoming, the Sybille Valley, and the altitude of 5,000 feet is represented by the Wheatland Experiment Farm under Ditch No. 2, of the Wyoming Development Company, in Laramie County, being donated by that company.

As the report of the Governor of Wyoming for 1889 states that four-fifths of this State is between the altitudes of 4,000 and 8,000 feet, it is evident that the farming and grazing lands of Wyoming are now well represented. As soon, however, as the Station funds will permit, it is intended that other experiment farms will be established.

It being the duty of the Station not only to acquire useful and practical information, but also to diffuse the same among the farmers and grazers of Wyoming, there will be distributed each year a number of bulletins containing reports of the various experiments. It is hoped, also, that Farmers' Institutes will be held in different parts of the State so that the Station workers can talk personally with our citizens about the experiments.

The establishment of the Experiment Station in connection with the Agricultural College Department of Wyoming University is fortunate. The Station has not the funds to pay for the necessary trained Professors and well equipped Laboratories which the University is granting it. It is due these Professors to state that they

are now working on their former salaries, but that to facilitate the season's work and to secure an early issue of this publication, the work on the following reports, without exception, has been done free and in time that was almost fully occupied with other duties. This work has been cordially done, recognizing that in a new State each must help the other, and in the hope of a bright future for agriculture in Wyoming.

THE FARM WORK IN PROGRESS.

REPORT OF THE AGRICULTURIST.

To facilitate the planting and measurement of crops and the keeping of accurate records, a forty-acre tract on each of the Experiment Farms has been divided into 36 one-acre plats, separated by cross-roads, which, with the surrounding road, occupy the other four acres. These 36 Acre Plats have the same numbers and sub-divisions as the 36 sections in a U. S. government township.

Each of the 40-acre tracts has been plowed and fenced with barbed-wire fence. The staple crops, in many varieties, have been planted on each. On the Wyoming University Experiment Farm, at Laramie, six acres are planted with cereals, one acre with potatoes, one with field peas, one with sugar beets, one with sorghum and corn, one with turnips and carrots and five with grasses and forage plants, all in many varieties, for tests and for distribution among the farmers of Wyoming. Similar crops are planted on each of the Experiment Farms. At the Lander Experiment Farm fruit and forest trees are planted. Aerial irrigation will be tested on the Saratoga Experiment Farm. At the Sheridan, Sundance and Wheatland Experiment Farms extensive trials of field corn are being made. The crops on the Sundance Experiment

Farm will not be irrigated, as that region receives the greatest rain-fall.

UNITED STATES GRASS EXPERIMENTS WITHOUT IRRIGATION.

On the 8th day of April the United States Secretary of Agriculture authorized the Wyoming Agricultural Experiment Station to experiment with grass and forage plants without irrigation under the direction of the United States Botanist. Three hundred dollars were appropriated to pay for seeds and expenses. It was recommended that at least five acres be planted ; that as far as possible experiments be tried with the native species of Wyoming, and that the temperature and rain-fall during experiments be carefully recorded.

The aim of the experiments is to find species of grass or methods of treatment that will improve the vast grazing grounds of this State which are difficult to irrigate.

Ten acres of land were selected near Laramie which represent the average soil and climate of the Laramie Plains. Four of the acres were drilled into the unprepared prairie with an Havana press drill. One acre was sown broadcast on the prairie and harrowed in. The other five acres were plowed at different depths, part subsoiled, and all harrowed and clod-crushed. Four of the plowed acres were drilled and one sown broadcast and harrowed in. Strips of all the grasses planted were rolled, or top-dressed with manure or with land plaster.

The following grasses and forage plants were selected :

Poa nemoralis (Northern Blue Grass), Dactylis glomerata (Orchard Grass), Panicum virgatum (Switch Grass), Aira caespitosa (Northern Hair Grass), Trifolium incarnatum (Scarlet Clover), Trifolium hybridum (Alsyke Clover), Medicago sativa (Alfalfa), Melilotus alba (White Sweet

Clover), Onobrychis sativa (Esparsette or Sanfoin), Hedysarum coronarium (Northern Lupin), Galega officinalis, Anthyllis velueriana (Land Clover), Poterium sanguisorba (Burnet), Panicum miliaceum (Indian Millet), Bromus Schraderi (Rescue Grass), Bromus inermis (Wild Chess), Festuca elatior (Fall Fescue), Lolium perenne (Rye Grass), Phalaris arundinacea (Canary Grass) and Sorghum vulgare, var. cernuum (Guinea Corn).

For comparison and test three acres of prairie on the Wyoming University Experiment Farm is sowed with the same grasses and will be irrigated. Five other acres of prairie will be flooded to test the effect of irrigation on the natural grass.

RETENTION OF SOIL MOISTURE.

Recent experiments in the Laboratories of the Johns Hopkins University have shown that in one gram of loamy soil there are 3,740,000,000 particles. To the surface of each of these minute particles a thin film of moisture adheres by "capillary" attraction. The tips of the rootlets of plants have the power to absorb this hygroscopic water with the substances it holds in solution. The spaces between the particles of soil should be filled with air. If filled with water the plant will be killed by drowning. Soggy soil being rare in Wyoming, the thickness of the film of moisture on the soil particle is the vital problem. Further experiments in the above Laboratories have shown that certain alkalies have the power to thicken and retain the film of moisture on the soil particle. Experiments with these chemicals are being tried on the Wyoming University Experiment Farm and Grass Fields, in the hope of good results to our arid soils.

Gypsum and many other crystals have the property of absorbing and retaining vast amounts of moisture. It is probable that the rootlets of plants have the power to

absorb this water of crystallization. Researches on this point are in progress at the Station. One of the substances used is the Ground Gypsum (Land Plaster) and Calcined Gypsum (Plaster of Paris), prepared by the Rocky Mountain Plaster Stucco Manufacturing Company, at Red Buttes, Wyoming, and furnished by Wm. Lawrence, of Laramie. In moist climates this gypsum is used as a reagent to set free the potash, nitrates and phosphates in the soil. In this climate gypsum may be found to have the further merit of absorbing water in wet times and of retaining it for the use of plants in dry times. In this connection experiments will be tried with our many native phosphates, nitrates and other fertilizers and with the waste products of the glass and soda works.

PROPOSED WORK IN HORTICULTURE.

REPORT OF THE HORTICULTURIST.

Horticulture may be divided into: 1, Landscape gardening; 2, Olericulture, or garden vegetables; 3, Floriculture; 4, Pomology, or fruit culture; 5, Seed culture, the selection and propagation of seeds, vitality of seeds, etc.

Only a short account of the work in progress is given and this is largely prospective.

LANDSCAPE GARDENING.

This is being carried on upon the University campus. Laying out drives and walks, preparing the ground and planting lawns, setting out trees and shrubs for hedge is well under way.

The question of what to plant must be determined by experiment. The rigors of our climate almost make the distinction of different trees for different purposes fade into

insignificance. Any that we can make grow will find a place. The cottonwood, despised in some localities, on account of its hardy character has a first place with us for all but lawn decoration.

The following are the trees and shrubs that are on hand for trial:

TREES.

From O. D. Shields, Loveland, Colo.—Green Bark Cottonwood (Populus angustifolia), White Ash (Fraxinus Americana), Carolina Poplar (Populus sp. ?), Mountain Ash (Pyrus Americana), Russian Olive (Olea).

From Mr. Allyn.—Native Cottonwoods (Populus sp. ?), Evergreens (six varieties).

From D. Fisk.—Balm of Gilead (Populus candicans), Russian Mulberry (closely allied to Morus nigra), Honey Locust (Gleditschia tricanthos), White Willow (Salix alba).

SHRUBS.

From Dr. Finfrock and Cold Spring Seed Farm.—Buffalo Berry (Shepherdia argentia).

From Colorado Agricultural College.—Barberries (Berberis.)

From Mr. Collins.—Lilacs (Syringa).

From D. Fisk.—Snow Ball (Viburnum Opulus).

GARDEN VEGETABLES.

Test of varieties of potatoes, peas, beans, onions, etc. Non-saccharine and saccharine sorghums. Corn, rhubarb and root crops. Yield on new land.

FLORICULTURE.

In this connection and economic Botany a green house is needed. All that can will be done with wild and tame flowering plants for decoration.

POMOLOGY.

The small fruits, wild and tame. Hardy varieties of Russian apples, pears, plums, cherries, etc.

SEED CULTURE.

Comparative vitality of northern grown (Minnesota) and Colorado seeds. Practical tests on the farm.

Seeds have been donated by the Department of Agriculture at Washington, Colorado Agricultural Experiment Station, Johnson & Co., of Richmond, Va., and Cold Spring Seed Farm, Big Horn, Wyo.

THE GRASSES OF WYOMING.

In Wyoming the importance to every stockman and farmer of a bountiful supply of grass on his land is apparent. In no State is the question of how to produce good pasture and hay land of greater moment. Being one of the newest and most progressive of States, and lying west of the 100th Meridian in the great arid district with elevations above sea level of from 3,000 to 10,000 feet, and consequent diversions of climate, the writer doubts if there is a commonwealth on the globe in which the study of, and experimentation with, grasses and forage plants promises to bring forth greater or more startling results, both from remunerative and scientific standpoints.

As yet the wealth of Wyoming depends largely upon the thousands of cattle, sheep and horses which exist on her broad pastures. "Grass is flesh," a statement so far-reaching it needs no further comment.

As the population increases the land must be made more productive. At present where a ranch of 10,000 acres will support 250 head of horses (such a ranch has been visited and the stock, while in fair condition, are by no means fat after coming through the winter), it ought to be made to support twenty times that number, or 5,000

head. One-half of this increase would make prosperous Wyoming ten times more prosperous.

The problem presents many difficulties, and to obtain the desired results will take years of patient and careful investigation.

GRASS GARDENING.

Under irrigation small plats of each of the varieties of grasses and forage plants, of which we can obtain seed this year, will be sown on the farm. Sods of the native grasses also will be set and conditions and progress carefully noted. Later, if they can be obtained, seeds of the native grasses will be sown in separate beds and some experiments tried by mixing different varieties.

The native grasses, on account of ther property of winter-curing and nutritive qualities, are valuable for pasturage. There are few if any more nutritive hay grasses than our native Blue Stem, Agropyrum glaucum and violaceum. One of our most valuable grasses for pasture, the Buchloe dactyloides (Buffalo Grass), is being exterminated by civilization. Its patches of matted sod on the plains are, to all appearances, growing smaller and wider apart. In view of these facts the study of, and experimentation with, the native grasses, to improve and perpetuate them, is of first importance.

NATIVE GRASSES.

In connection with this subject a brief report of the grasses indigenous to the Experiment Farm at Laramie, and others which have been determined, may be of interest. Only three species have been recognized on the farm, viz: Buchloe dactyloides (Buffalo Grass or Mesquite), Bouteloua oligostachya (Grama Grass) and Agropyrum glaucum (Blue Stem). These are the principal grasses of the plains and clothe them in their characteristic green in spring and early summer. Others found on the river

bottom near Laramie were these: Sporobolus airoides Torr. (Bunch Grass or Salt Grass), not valuable for hay but relished by stock and makes good pasturage; Stipa spartea (Porcupine or Anon Grass), cut young it makes a good hay but when the seeds are ripe their long awns and sharp beards make them irritable, somtimes penetrating the skins of animals; Alopecurus sp? (Fox Tail), of no value, when fed to stock the sharp awns cause sore mouths.

A specimen of Panicum amarum, Ell, was found in bloom in the hills east of Laramie. Its value is unknown.

Mr. Peyton, of Saratoga, Wyo., through the Director presented the Station with about a dozen species of grasses and sedges, collected near that place, and of which the following have been identified: Alopecurus alpinus, Sm., (Fox Tail), probably of no value; Beckmannia erucaeformis, Host., (Water or Slough Grass), stock are said to be fond of it; Elymus Canadensis, L., (Wild Rye, Lyme Grass or Terrell Grass); the specimen sent is nearly four feet; when used for hay should be cut young, as with age it becomes coarse and harsh.

Elymus condensatus, Prest., (Grant Rye Grass), one of our coarest grasses growing in damp soils from six to twelve feet high. Unless cut young is of little value for hay. Phleum pratense, L., (Timothy, Herd's or Cat's Tail Grass), known by everyone; is a native of the South and Eastern States and is said to have been cultivated as early as 1720. Phleum alpinum, L., found in high elevations; small and not vigorous.

Spartina cynosuroides, Willd., (Cord Grass); readily recognized by its coarse stems and one-sided spikes. The latter, 5 to 10 on the stalk, much resemble those of the Grama Grass in general appearance. Leaves long. It is of little value, as stock will not eat it. Besides these there were represented two species of Sporobolus, one

Alopecurus, Panicum and Poa. The others being dry and imperfect, it was impossible to determine them.

There are several species of the Rush Family [Juncus] and the Sedges which are called Wire Grass by stockmen. These are valuable and form a large portion of the hay in some sections. Only one has been found in blossom and determined. It is closely related to Carex rupestris, All., only differing in having two instead of three stigmas. It comes up abundantly and blossoms quite early in the spring; looks very much like a grass. It grows from 1 to 5 inches high and has a brown colored spike, less than one-half inch long, at the top of the stem.

In this short article I have not attempted to give descriptions only in a general way. It is hoped that a thorough botanical survey of the State may be made and an herbarium of all the plants represented built up for reference.

IRRIGATION.

In connection with the subject of irrigation I give a short report of what has been done on the farm.

Opposite the highest point on the farm a headgate was placed in the main canal and a lateral constructed from it to the large weir-box, through which it is expected all the water used will run.

In order to accurately measure all the water which runs on the farm for irrigating purposes and all that which runs off as waste water, to find the "duty" of water, two large weir-boxes were made.

I have adopted the Cippoletti form of weir, which is so constructed that it eliminates the co-efficient of contraction in the formula and consequently makes the computations much more simple and easy. [For a description of this weir see Bulletin No. 13 of the Colorado Agricultural Experiment Station.]

The dimensions of the weir-boxes were determined by the conditions necessary to the most accurate measurement for the size of weir needed. They were made 8 feet long, 6 feet wide, one 3½ and the other 3 feet deep in the clear. The weirs are made in separate boards to fit the front of the box, and are interchangeable. The depth of the water flowing over the weir will be determined by a self-registering apparatus, the Wyoming Nilometer, designed by State Engineer Mead, a cut of which is given in his Second Annual Report.

The slope of the Laramie Experiment Farm is such that irrigating it will be comparatively simple and easy. Ditches have been plowed on each side of the drives, which will allow each acre to be irrigated separately if desired.

On the lower side of the farm, in a distance of about 650 feet there is a fall of 5.8 feet nearly, but it is thought that the soil is of such a nature that it will not wash badly.

Irrigation in all its forms will be applied—surface, furrow and bed irrigation at the Farm, and sub-irrigation at the University, for which purpose about 900 feet of pipe is now laid.

GEOLOGY OF THE LARAMIE PLAINS.

REPORT OF THE GEOLOGIST.

In giving the geological horizon of the Wyoming University Experiment Farm, Grass Fields and Garden, the writer is at variance with the United States geological maps which place the Laramie Plains in the Dakota Group.

From a study of excavations made in the city of

Laramie, and of the red sandstone quarries to the north, it is certain that Laramie and the Grass Fields are in the Triassic formation. The red sandstone strata dips about 30 degrees to the west, passing beneath the Big Laramie River, at the Experiment Garden, and must be several thousand feet beneath the surface at the Experiment Farm two miles to the west. In this locality the Jurassic does not appear to rest upon the Triassic. The position of the formation overlying the Triassic can only be determined by the fossils which are not yet studied. In digging the irrigation ditches on the farm a thin layer of yellow sandstone was found. W. H. Reed, formerly a collector for O. C. Marsh, of Yale College, informs me that there is an out-crop within a few miles of the farm of a similar sandstone which contains fossils. This will be studied in due time.

Some middle or upper Cretaceous fossils are found 25 miles north of Laramie, and also in the Laramie Group, 20 miles to the northwest. At the latter point a stratum of coal dips northwest toward the foot-hills. The crest and southeast side of the mountain, of which the Laramie Group was once the northwestern slope, seems to have been carried away. This mountain must have extended to within a few miles of the Experiment Farm, at which point another mountain probably rose to the east, the west slope of which was covered by the Laramie Group, conformable with the Cretaceous and Triassic beneath. The latter mountain has also been torn down by the hand of time, laying bare the Cretaceous formation whose crumbling and disintegrated rocks mixed with local drift gravel form the soil of the Experiment Farm. This is the most noted of all the geological formamations for its great variety of soils.

The Triassic is the lowest formation of Mesozoic

Time, and in this vicinity does not exhibit the marked volcanic or eruptive origin of the Palisades of the Hudson or of Mounts Tom and Holyoke in Massachusetts, nor have reptilian foot-prints, so characteristic of the Connecticut Valley sandstone, been found here. The next formation above the Triassic in Europe is the Jurassic, but in the Rocky Mountain Region of America the two generally are so blended together as to be called the Jura-Trias, but near Aurora, sixty miles from Laramie, Ammonites are found which separate the Jurassic from the Triassic. The Cretaceous is the upper of the three sub-divisions of Mesozoic Time, and in Europe is divided into Upper; Middle and Lower Cretaceous.

The corresponding sub-divisions of the Rocky Mountain region are :

Cretaceous.	Upper,	Fox Hill, Ft. Pierre.
	Lower,	Niobrara, Fort Benton, Dakota.

The Jurassic and Cretaceous formations in Wyoming are exceedingly rich in fossils and have furnished Professors Marsh, Cope and others with an immense quantity of gigantic bones of huge Reptiles and Saurians that once basked in the sunshine upon the shores of the Cretaceous and Jurassic Seas.

The Laramie Group, in which the coal of Wyoming is found, is considered by some as the lowest of the Tertiary, but it is more generally considered as the transition period between the Cretaceous and Tertiary, partaking of the nature of both, but differing enough not to be classified with either, but is a connecting link between the two. It undoubtedly once overlaid the region of the Farm, but has been worn and washed away, leaving the Cretaceous

as the foundation of the Experiment Farm of the University of Wyoming.

NOTE ON SOIL ANALYSIS.

BY THE CHEMIST.

A future Bulletin will contain detailed descriptions, and a tabulated statement, of the soils from each of the Experiment Farms, so far as analyzed.

There is enough àlumina in the soil at the Wyoming University Experiment Farm to give it body and a good consistency. It is a light sandy loam, possessing enough of the essential ingredients for the native grasses to thrive well under irrigation alone. On a neighboring ranch, in similar soil, the blue joint Agropyrum glaucum has produced one and one-half tons per acre. Time and space will not permit any further statement concerning our soils for the present.

A PRELIMINARY REPORT ON THE FLORA INDIGENOUS TO THE WYOMING UNIVERSITY EXPERIMENT FARM.

BY THE BOTANIST.

As a matter of record, and as indicating to some extent the climate and soil of this part of the State, viz., the Laramie Plains, it is has been thought advisable to insert in this first Bulletin a list, briefly descriptive, of the plants found growing in the natural soil and without irrigation on the land used by the Experiment Station.

From this list the grasses are omitted, as they will be treated elsewhere in this Bulletin by the Horticulturist. The list is necessarily quite incomplete, as it includes only

those plants found to date [May 20th] this season. An effort will be made to complete it by adding to it the plants that shall successively appear throughout the year. In these lists no attempt at systematic arrangement has been made.

1. Townsendia sericea.—The earliest plant to blossom, and that at once attracts the attention of the collector, is this compositæ. It is low, depressed, apparently acaulescent, and bears one to several rather large heads, closely sessile among the clustered, linear-spatulate leaves. Rays numerous, narrow, white varying to purple.

2. Phlox caespitosa.—

3. Phlox Douglasii.—These two species both grow very abundantly, the former appearing earliest, growing in large dense mats; the latter less densely tufted, flowers larger and leaves narrower but longer.

4. Echinocactus Simpsoni.—This species of cactus is quite common on the Laramie Plains. It is globular in form, sometimes three to four inches in diameter, usually growing half buried in the sandy soil.

5. Œnothra caespitosa.—An acaulescent "Evening Primrose," with large showy white petals, changing to rose-color.

6. Leucocrinum montanum [Mountain Lily.]—A beautiful flower, the white perianth of most delicate texture and appearing just above the ground.

7. Plantago eripoda–?–[Plantain]—This species of Plantain is found sparingly on the farm. It seems to thrive best in dry and sandy but rather low situations.

The following list comprises those plants not yet in blossom, but readily identified by other characteristics:

1. Opuntia Rafinesquii.—A common, tufted, prostrate, flat-stemmed, many jointed cactus. An exceedingly annoying plant in many unbroken plains pastures.

2. *Cleome integrifolia* [Rocky Mountain Bee Plant.]—This plant grows in great abundance in many parts of the plains, the long racemes of large, showy, reddish-purple flowers being visible for a long distance.

3. *Malvastrum coccineum.*—Low and hoary, with pedate leaves, bearing showy pink-red flowers throughout the season.—Common everywhere.

4. *Achillea Millefolium* [Yarrow.]—A weed common everywhere in the northern hemisphere and known by its finely dissected leaves and corymb-like cyme of numerous small heads with white rays.

5. *Bigelovia graveolens, Var albicaulis* [Golden-rod.]—Very common both in the mountains and on the plains. It grows in small, dense clumps, the numerous branched stems covered with a dense white tomentum, and bearing numerous small crowded heads.

6. *Cnicus scariosus* [Thistle.]—Stems a foot high or more; leaves white tomentose on the under side; lanceolate in outline with long, prickly lobes; flowers almost white.

7. *Artemissia pedatifida–?*–[Wormwood]—A small very dwarf sage-brush with dissected leaves, crowded in tufts on the woody root-stock, flowering presumably later in the season. Strong scented.

8. *Delphinium azureum* [Larkspur.]—Stem slender, branching and slightly pubescent; leaves cleft, the lobes linear; flowers in a raceme, sky-blue, the spur curved.

9. *Lichens.*—It may be well to note that Lichens are found in great abundance everywhere on the farm.

PROMISING PLANTS FOR CULTIVATION

The following is a list of the shrubs and plants native in the foothills near Laramie which, on account of their fruits, it might be well to try on the Experiment Farm.

It seems probable that the cultivated varieties would do well here where the native species seem to thrive.

1. Fragaria vesca [Strawberry.]—Strawberries thrive exceedingly well in the moist places and along the streams in the mountains, and if properly protected and irrigated would bear abundantly anywhere in the State.

2. Rubus strigosus [Red Raspberry.]—This is the common red raspberry of the mountains, known to all as very prolific. Cultivated varieties, if well protected through the winter, would probably pay richly for the trouble.

Blackberries, being so closely related, ought likewise to do well, though they are not found native, I believe.

3. Ribes oxyacanthoides [Gooseberry.]

4. Ribes floridum [Currant.]—Both the gooseberry and the currant ought to prove perfectly hardy here, judging by the appearance of the native species.

5. Shepherdia argentea [Buffalo Berry.]—In the buffalo berry we have a shrub perfectly hardy in other parts of the State, and is certainly worthy of trial.

6. Berberis repens [Barberry.]—A cultivated variety is grown successfully at Fort Collins, Colorado.

7. Amelanchier alnifolia [Serviceberry.]

8. Prunus demissa [Wild Cherry.]—The last two, while themselves valueless, may suggest species worthy of trial.

WEATHER REPORT FOR APRIL AND MAY, 1891.

BY THE CLIMATOLOGIST.

The Weather Instruments of the Experiment Station were not adjusted for records until May 15th. Upon request Dr. L. S. Barnes, Local Observer at Laramie for the

United States Signal Service, has kindly permitted the publication in the Bulletin of the following tables prepared by him :

WEATHER REPORT FOR APRIL.

TEMPERATURE.							PRECIPITATION.	
DAY.	7 A. M.	2 P. M.	9 P. M.	MEAN.	MAX.	MIN.	TOTAL AMOUNT OF RAIN.	AV. D'P'H SNOW IN INCHES.
1	15	26	17	18.75	26	14		
2	14	31	21	21.00	32	7		
3	10	32	23	22.00	34	12		
4	21	34	24	25.75	35	18		
5	24	52	36	37.00	52	14		
6	33	55	36	40.00	55	31		
7	39	54	39	42.75	56	33		
8	29	36	27	27.25	40	27		
9	29	38	34	33.75	43	25		
10	35	55	36	40.50	56	26		
11	34	60	44	45.50	61	28		
12	38	40	34	36.50	50	33		.25
13	32	45	34	36.25	46	29		Trace.
14	36	50	38	40.50	55	28	Trace.	1.00
15	36	38	31	34.00	45	36	.25	
16	2	50	36	38.50	57	24		
17	36	42	39	39 00	50	27		
18	35	44	33	36.25	46	32		1.00
19	32	50	40	40.50	53	31		
20	35	43	35	37.00	51	32		
21	36	50	40	41.50	54	26		.25
22	35	57	43	44.10	59	30		
23	45	66	55	52.75	69	32		
24	50	72	72	55.50	73	38		
25	56	71	38	50.75	71	38		
26	35	47	40	40.50	50	28		
27	40	62	46	49.00	63	26		
28	52	69	52	56.25	69	31		
29	52	63	46	51.75	64	40		
30	45	58	46	48.75	61	34		
				39.45			.25	2.50

WEATHER REPORT FOR MAY.

	TEMPERATURE.						PRECIPITATION.	
DAY.	7 A. M.	2 P. M.	9 P. M.	MEAN.	MAX.	MIN.	RAIN & MELTED SNOW.	SNOW.
1	45	57	46	48.50	62	31		
2	41	63	44	48.50	60	37		
3	53	64	49	53.75	66	33		
4	51	70	53	56.75	71	35		
5	52	75	58	61.25	76	38		
6	58	70	53	58.50	74	39		
7	58	69	52	57.75	71	39		
8	55	70	48	55.25	71	44		
9	50	56	38	45.50	62	34	Trace.	
10	42	56	41	45.00	57	30		
11	45	52	30	46.25	58	33	Trace.	
12	42	60	47	49.00	62	34		
13	50	64	49	53.00	66	34		
14	50	52	44	47.50	65	37	.53	
15	44	37	34	37.25	47	31	1.93	Snow.

AN ACT TO ESTABLISH AGRICULTURAL EXPERIMENT STATIONS.

In connection with the colleges established in the several States under the provisions of an act approved July second, eighteen hundred and sixty-two, and of the acts supplementary thereto.

Be it enacted in the Senate and House of Representatives of the United States of America in Congress assembled: That in order to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture and to promote scientific investigation and experiment respecting the principles and applications of agricultural science, there shall be established, under direction of the college or colleges or agricultural department of colleges in each State or Territory established, or which may hereafter be established, in accordance with the provisions of an act approved July second, eighteen hundred and sixty-two, entitled "An act donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts," or any of the supplements to said act, a department to be known and designated as an "agricultural experiment station;" *Provided,* That in any State or Territory in which two such colleges have been or may be so established the appropriation hereinafter made to such State or Territory shall be equally divided between such colleges, unless the Legislature of such State or Territory shall otherwise direct.

SEC. 2. That it shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic

questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories.

SEC. 3. That in order to secure, as far as practicable, uniformity of methods and results in the work of said stations, it shall be the duty of the United States Commissioner of Agriculture to furnish forms, as far as practicable, for the tabulation of results of investigation or experiments; to indicate, from time to time, such lines of inquiry as to him shall seem most important; and, in general, to furnish such advice and assistance as will best promote the purposes of this act. It shall be the duty of each of said stations, annually, on or before the first day of February, to make to the Governor of the State or Territory in which it is located a full and detailed report of its operations, including a statement of receipts and expenditures, a copy of which report shall be sent to each of said stations, to the said Commissioner of Agriculture and to the Secretary of the Treasury of the United States.

SEC. 4. That bulletins or reports of progress shall be published at said stations at least once in three months, one copy of which shall be sent to each newspaper in the States or Territories in which they are respectively located, and to such individuals actually engaged in farming as may request the same, and as far as the means of the station will permit. Such bulletins or reports and the annual reports of said stations shall be transmitted in the mails of the United States free of charge for postage, under such regulations as the Postmaster General may from time to time prescribe.

SEC. 5. That for the purpose of paying the necessary expenses of conducting investigations and experiments and printing and distributing the results as hereinbefore prescribed, the sum of fifteen thousand dollars per annum is hereby appropriated to each State, to be specially provided for by Congress in the appropriations from year to year, and to each Territory entitled under the provisions of section eight of this act, out of any money in the Treasury proceeding from the sales of public lands, to be paid in equal quarterly payments, on the first day of January, April, July and October in each year, to the treasurer or other officer duly appointed by the governing boards of said colleges to receive the same, the first payment to be made on the first day of October, eighteen hundred and eighty-seven: *Provided, however*, That out of the first annual appropriation so received by any station an amount not exceeding one-fifth may be expended in the erection, enlargement or repair of a building or buildings necessary for carrying on the work of such station; and thereafter an amount not exceeding five per centum of such annual appropriation may be so expended.

SEC. 6. That whenever it shall appear to the Secretary of the Treasury from the annual statement of receipts and expenditures of any of said stations that a portion of the preceding annual appropriation remains unexpended, such amount shall be deducted from the next succeeding annual appropriation to such station, in order that the amount of money appropriated to any station shall not exceed the amount actually and necessarily required for its maintenance and support.

SEC. 7. That nothing in this act shall be construed to impair or modify the legal relation existing between any of the said colleges and the government of the States or Territories in which they are respectively located.

SEC. 8. That in States having colleges entitled under this section to the benefits of this act and having also agricultural experiment stations established by law separate from said colleges, such States shall be authorized to apply such benefits to experiments at stations so established by such States; and in case any State shall have established, under the provisions of said act of July second aforesaid, an agricultural department or experimental station, in connection with any university, college or institution not distinctively an agricultural college or school, and such State shall have established or shall hereafter establish a separate agricultural college or school, which shall have connected therewith an experimental farm or station, the Legislature of such State may apply in whole or in part the appropriation by this act made, to such separate agricultural college or school, and no Legislature shall by contract express or implied disable itself from so doing.

SEC. 9. That the grants of moneys authorized by this act are made subject to the legislative assent of the several States and Territories to the purposes of said grants; *Provided*, That payment of such installments of the appropriation herein made as shall become due to any State before the adjournment of the regular session of its Legislature meeting next after the passage of this act shall be made upon the assent of the Governor thereof duly certified to the Secretary of the Treasury.

SEC. 10. Nothing in this act shall be held or construed as binding the United States to continue any payments from the Treasury to any or all the States or institutions mentioned in this act, but Congress may at any time amend, suspend or repeal any or all the provisions of this act.

Approved March 2, 1887.

UNIVERSITY OF WYOMING.

Agricultural College Department.

WYOMING EXPERIMENT STATION,

LARAMIE, WYOMING.

BULLETIN NO. 2.

AUGUST, 1891.

PLANT LICE.

The Bulletins and Annual Reports of this Station will be sent the residents of this State, upon request. Address the Director, Laramie, Wyo.

WYOMING
Agricultural Experiment Station.

UNIVERSITY OF WYOMING.

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Wyoming University Experiment Farm,	F. J. NISWANDER. Sup't
Laramie Experiment Garden,	LAWRENCE FEE, Foreman
Laramie Tree Experiments,	The Horticulturist in charge
Laramie [U.S.] Experiment Grass Fields,	The Director in charge

PLANT LICE.

BY F. J. NISWANDER, ENTOMOLOGIST.

Perhaps there is no family of insects that is more widely distributed, does more damage to vegetation and is more generally known than plant lice (*Aphidæ*). They are great pests in the greenhouse, in the garden, and do great damage to our forest, shade and fruit trees, causing the foliage to curl and drop from the trees. The members of this family not only feed upon the foliage of plants, but many species attack the branches and trunks of trees, while others live entirely upon the roots.

The small green insects (Fig. I.) that infest the foliage of the cottonwoods of this State are members of the family technically known as *Aphidæ*. Not a cottonwood has escaped them, and the damage they are doing to the trees is considerable. Each louse is furnished with a sharp, hollow beak or rostrum. Those insects possessing beaks and taking their nourishment by piercing the tissue of the plant and then sucking up the juices are said to be ***haustellate***. These lice exist in two forms, one apterous or wingless, the other having wings. Late in the fall the eggs are deposited upon the twigs and buds of the trees. Early in the spring, before the buds have fairly opened, the eggs hatch and the young

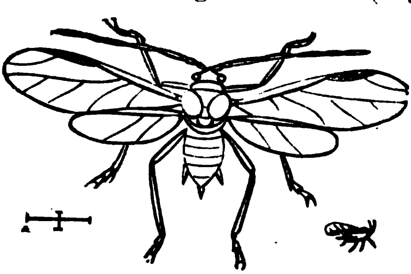

Fig. I.—Plant Louse.

lice crowd upon the buds, eager to destroy the tender foliage. It is surprising how rapidly they increase. The first lice that hatch are females, and their reproduction is somewhat curious. They do not deposit eggs, but instead young lice are born. One female will within a comparatively short time produce enough lice to populate a tree. The young lice, as soon as they reach maturity, will in the same way continue the process of reproduction. Thus it is that by the time the tree has taken on its foliage the leaves will be covered by myriads of these small aphids, eagerly sapping the life-blood of the tree.

Each louse has on the sixth abdominal segment two small projecting tubes, called nectaries. From these exude the "honey dew," a sweet liquid much sought by ants, bees and flies. This liquid is often secreted so copiously that the leaves become coated with the sticky substance and large drops fall upou the ground beneath. I have noticed these drops, on the stone walks of Laramie, so thick that a casual observer would mistake them for drops of rain.

The two species of lice that are the most common in this locality on the cottonwoods are *Pemphigus populimonilis?* Riley and *Chaitophcrus viminalis?* The former is less numerous than the latter. The first named species attacks the leaf near its margin. By the continual puncturing and irritation to the leaf the growth is retarded at that point. The growth on the opposite side of the leaf is so rapid that within a short time a pocket-like cavity is formed, in which the lice live. The other species differs in its habits from its relative. Instead of forming a gall or protective covering for themselves, they congregate upon both sides of the leaf near the mid vein, and by

their continued puncturing soon cause the foliage to curl, become brown and finally drop from the tree.

Nature has provided us with checks against the ravages of these pests. There are numerous small "four-winged flies" that deposit their eggs in these lice, by means of a sharp ovipositor. It was these little friends that saved the wheat crop two years ago in the East when its destruction was threatened by these lice. The larvæ from the eggs of these "four-winged flies" live upon the vital organs of their hosts, use their skin for a pupal covering and eventually emerge ready to continue their warfare.

The small reddish yellow and brown "lady bugs" (*coccinellidæ*) are great checks upon the increase of these plant lice. During a warm day these little beetles are seen busily depositing their eggs among the lice and upon the trunks and branches of the trees. These eggs hatch into a grub, which will within a short time destroy an entire colony of aphids.

Fig. II.—Syrphus Fly.

Several species of flower flies, Fig. II., (*Syrphidæ*) are great aids in destroying these lice. The larvæ (Fig. III.) of these flies are maggots, and the number of lice one of these maggots will destroy in a day seems almost incredible.

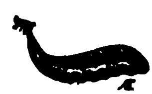

Fig. III.—Larva of Syrphus Fly.

In addition to Nature's checks upon the ravages of insects, artificial means are resorted to. Various remedies have been suggested for the destruction of plant lice, but none seems to be more effective than an emulsion of kerosene oil and soap. This emulsion is made as follows:

"Dissolve in two quarts of soft water one-fourth pound of hard soap by heating to the boiling point, then add one pint of kerosene oil and stir vigorously for from three to five minutes."—(Cook). The best way to do the stirring is to pump the mixture from one vessel into another, or back into the same vessel, with a good force pump. This will form a thick creamy mass that may be diluted to any desired strength. To the mixture just formed we then add ten pints of water. This is the usual strength, although the emulsion will kill the lice if twelve pints of water are added. It is better to add the larger amount of water, as there is some damage done to the foliage when only ten pints of water are added. Throughout the State are numerous oil wells and springs which might be utilized. It is possible that where the crude oil is used a larger quantity of the material would be necessary. This emulsion should always be applied with a force pump.

Another excellent remedy for plant lice is Buhach or Pyrethrum. This is the yellow insect powder sold in the shops for the destruction of insects. If two tablespoonfuls of this be thoroughly stirred in a large pail full of water and sprayed upon the trees excellent results will follow the application. Too much care cannot be taken to make a thorough application, otherwise it will do no good.

In the application of insecticides there is nothing that will insure success like thoroughness. A dashing spray, one that will reach every leaf upon all portions of the tree, is one of the essentials of a good force pump. There are many pumps placed upon the market and all have certain features that are commendable.

A. I. Root, Medina, Ohio, sells a very convenient

pump for $1. The Whitman Fountain pump, manufactured by J. A. Whitman, Providence, R. I., is excellent and will answer the purpose of a more expensive pump. It costs $6.50 at the factory. The Field Force Pump Co., of Lockport, N. Y., sell an excellent pump for $2.50. The Nixon pump, of Dayton, Ohio, is furnished with a zinc lined tank and can be moved from tree to tree on a wheelbarrow. It is also furnished with a superior nozzle, and is perhaps the best general purpose pump placed on the market. It sells for $15.

I desire to express my thanks to Prof. A. J. Cook, of the Michigan Agricultural College, for valuable suggestions and for the loan of the cuts for the Illustrations; also to Prof. L. O. Howard, of the Division of Entomology, Washington, D. C., for the identification of the lice sent him.

[NOTE.—The Entomologist of the Wyoming Agricultural Experiment Station will be pleased to receive insects from the residents of the State, and will endeavor to answer any inquiries concerning their life history or the best means of destroying them, if injurious. Insects can be sent by mail for one cent per ounce. If the specimens are dead they should be packed in cotton or wool to insure safe transportation, and enclosed in a tight wooden or tin box. NEVER SEND INSECTS IN A LETTER, as they will be crushed beyond recognition. Whenever it is possible live insects should be sent. Caterpillars, grubs, maggots, etc., should be supplied with enough of their food plant to last them until they have reached their destination. It is unnecessary to cut air holes in the boxes, as the amount of air required by insects is very small. When sending insects the name of the sender should be written on the package. Anyone sending specimens for identification will confer a favor by giving as full particulars as possible concerning their habits; for example, what plant it infests; whether it infests the roots, stems, twigs, buds or leaves; how long you have known it to be injurious, and what amount of damage it has done. The Director, on his recent tour through the State, arranged for collections of insects to be made by the Superintendents of the Experiment Farms at Lander, Saratoga, Sheridan, Sundance and Wheatland. Insects may be sent through those gentlemen. All packages and communications should be addressed to F. J. NISWANDER, Entomologist, Agricultural Experiment Station, Laramie, Wyo.

Univ. of Wyoming

UNIVERSITY OF WYOMING.

Agricultural College Department.

WYOMING EXPERIMENT STATION,

LARAMIE, WYOMING.

BULLETIN NO. 3.

NOVEMBER, 1891.

THE SUGAR BEET IN WYOMING.

The Bulletins and Annual Reports of this Station will be sent the residents of this State, upon request. Address the Director, Laramie, Wyo.

WYOMING
Agricultural Experiment Station.

UNIVERSITY OF WYOMING.

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SUNDANCE EXPERIMENT FARM,	THOMAS A. DUNN
WHEATLAND EXPERIMENT FARM,	MARTIN R. JOHNSTON

WYOMING UNIVERSITY EXPERIMENT FARM,	THE AGRICULTURIST IN CHARGE
WYOMING UNIVERSITY EXPERIMENT GROUNDS,	THE HORTICULTURIST IN CHARGE
UNITED STATES GRASS STATION,	THE DIRECTOR IN CHARGE

The Sugar Beet in Wyoming.

DICK MCLAREN, Agriculturist. E. E. SLOSSON, Assistant Chemist.

Wyoming is a natural sugar laboratory. The dry autumn of the Arid Region causes all the native plants to ripen with large stores of starch and sugar in root and bulb for rapid growth the next spring. The sugar beet is no exception to the rule. Its cultivated tendency to store starch and change the same to sugar is here greatly increased by climatic conditions. Irrigation in early summer causes a luxurious growth of leaves. As the water supply is gradually lessened, these leaves elaborate large quantities of starch and sugar to be stored in the thickening root. The irrigation is stopped, and the dry fall thoroughly ripens the beet, changing the starch to a rich store of sugar. Both Wyoming and Utah experience demonstrates that the irrigated beet is much richer in sugar than the beet that is prevented from ripening by the heavy fall rains of the Humid Regions.

THE DEMAND FOR BEET SUGAR.

Last year the world used upwards of six million tons of sucrose, the sugar of commerce. More than half of this amount was extracted from the sugar beet, about two-fifths from the sugar cane and a small quantity from the sugar maple, the sorghum cane and other plants.

and quaking asp are found in the foothills. The mean summer temperature varies from 50° in the southern foothills to 60° in the North Platte Valley. Except to the northward, killing frosts occur in May and September, and white frosts in the other summer months. As the annual rainfall is from eight to fourteen inches all crops must be irrigated.

The Laramie Experiment Farm of the Wyoming Experiment Station represents the average soil and climate of the Laramie Plains. From experiments on this Farm, and from answers to a circular letter sent to the farmers and ranchmen of Albany and Natrona Counties, the following varieties of farm crops and breeds of stock are recommended as adapted to this region :

Improved Fyfe, White Russian and Chili spring wheats have done well. Lawrence Fee, of Laramie, has good yields from the Oregon Red. Spring wheat, oats, rye, barley and flax do best drilled in north and south rows, in April, as early as the ground can be prepared. In Natrona County, May winter wheat is a success planted in September. Both winter wheat and winter rye will probably not do so well further south, but are worthy of trial, if drilled early, for fall pasturage, the Kansas Experiment Station having proved that it is beneficial to both grain and animal to pasture all the growth that would be killed by frost. Salter's spring rye yields well and can be cut green like oats for a fattening hay. Excelsior, Welcome and White Russian oats yield enormous crops of heavy grain and nutritious straw. Lionel Sartoris reports good success with the Black Tartarian oats on the Little Laramie. Four and six-rowed barley are successful and the grain cures bright in this dry climate. Both European

and common flax produce plump seed and a long fiber of extra strength. Japanese and Silver Hull buckwheat are well adapted to this cool climate.

Early Scotchman and Canada field peas do well and are the most promising grain food for swine. Artichokes would be a good addition. Allan H. Dick, of Red Buttes, reports a yield of sixty bushels per acre from Early May peas plowed-in in April. C. C. P. Webel, of Natrona, reports a yield of seventy bushels per acre of Yankee Flint corn planted May 1st. On the Laramie Plains field corn will not mature further than roasting ears, but large crops of fodder corn can be raised. Early Amber sorghum, German and African Millets are other good fodder plants. These and all kinds of hay cure so well in this dry air that they are almost as good as green food. The Utah Experiment Station has proved our air-dry corn fodder better than corn ensilage. Corn, Sorghums and Millets should not be planted before May 15th. Klein Wanzleben and Vilmorin sugar beets planted in May yield so well as to justify the building of a sugar factory.

Timothy, alfalfa and red top are the best tame grasses for hay. Orchard grass does well in Natrona County. Timothy may be sown broadcast on a melting snow, or drilled in as early as possible. E. S. R. Boughton, of Cooper, reports three tons per acre from timothy sown on natural sod and flooded. Alfalfa yields five to nine tons per acre in Natrona County, and is best sown with oats, thus gaining one extra crop. The oat stubble and young alfalfa hold the snow for protection the first winter. For this reason the aftermath should never be pastured from young or old alfalfa. But little irrigation

is needed and this should be stopped in time to ripen the alfalfa, thus avoiding winter-killing.

Grade Hereford and Shorthorn cattle are preferred for wintering on the range. It is being found more profitable to winter cattle and horses in fenced pastures, feeding hay during storms. The Ione Land and Cattle Company, at Cooper, raise Hereford cattle in this way, selling three and four-year-olds and fattening in winter with blue stem hay. B. B. Brooks, of Casper, prefers Galloways, selling at three years, and finds alfalfa hay the best fattening winter feed. Shorthorns and Jerseys are preferred for dairy cattle. R. E. Fitch, of Laramie, finds Merinos the most profitable range sheep, and Merinos and Shropshires for mutton, selling wethers at three to five years and ewes at seven years. Chopped corn has been fed with profit to mutton sheep. Native horses are preferred for the range and Normans and Clydes for farm horses. A few Berkshire swine, Cashmere goats and Spanish mules are raised. Rutabagas, sugar beets and carrots are profitably fed to stock in connection with blue stem, alfalfa or timothy hay. In the coldest weather they will freeze while being eaten, but are well adapted to fall and spring feeding. In California sun dried sugar beets have been successfully used in sugar making. The experiment should be tried of sun drying our sugar beets for winter stock food. They could be ground and fed alone or mixed with chopped grain. By using movable fences around part of the field rutabagas may be fed to cattle and sheep without the expense of digging and storing.

A fall crop which is successfully fed in the field in this way in cold countries is rape. Sheep and cattle fatten very rapidly on the rich green leaves. This will be tried by the Experiment Station in 1892.

HORTICULTURE IN ALBANY AND NATRONA COUNTIES.

B. C. BUFFUM, B. S.

Owing to the altitude of the Laramie Plains, which take up a large portion of Albany County, their exposure to heavy winds and late frosts, makes it probable that any extensive culture of orchard or tree fruits will not be successful. E. S. R. Boughton, near Cooper, says that the fruit trees which have been tried in that locality have all died, and in his opinion they will not live because of the exposure. It is believed, however, in the more sheltered localities hardy varieties will be more or less successful. The degree of success can only be determined by experiment.

The culture of small fruits is more promising, as they can be protected by covering in winter. Because of our dry, changeable winters, in any part of Wyoming shrubs and vines, excepting, perhaps, currants and gooseberries, should be covered with earth. Strawberries should be mulched. Among garden vegetables the root crops are the most successful, but other hardy crops, as peas, beans, cabbage, etc., do well. Belts of trees for wind-breaks are almost indispensable for all crops, especially fruit. In Laramie, protected by trees and houses, there are several varieties of crabapple trees which look thrifty and are in bearing. A word of caution may be well here regarding the use of water. As a rule crops are irrigated too much. In general it is not best to irrigate until the crops plainly show the need of water. Too much water makes the ground cold, allows so much evaporation that the alkali is left on the surface and retards growth. In the fall, however, before the water is turned out of the ditches, the

ground should be thoroughly soaked for fruits, that they may not dry out during the winter.

In Natrona County where ever water can be had for irrigation, along the sheltered North Platte Valley, all the more hardy fruits and vegetables would succeed as well as in other parts of the State. C. M. Cheney, Freeland, O. K. Garvey and J. A. Whittear, Casper, state that no fruits have been tried in that county.

The following crops and varieties are recommended. Only standard varieties are named and the one considered best is placed first in each case :

FRUITS.

Crab Apples—Transcendent, Siberian. Apples—summer, Duchess ; fall, Wealthy ; winter, Ben Davis. Plums—Miner, Weaver, DeSoto. Strawberries, standard varieties—Wilson, Crescent, Sharpless. Raspberries—Turner, Gregg. Blackberries—Wilson, Snyder. Gooseberries—Houghton, Downing, Industry. Currants—Red and White Dutch, Fay, Cherry.

VEGETABLES.

(From experiments on Laramie Experiment Farm.)

Potatoes—early, Early Rose, Early Ohio ; late, Late Rose, Mammoth Pearl, Blue Victor. Turnips—All varieties do well ; White Egg is finest for table use. Beets—all varieties. Carrots—Danvers' Half-Long, Oxheart. Parsnips—Hollow Crown, Imperial Guernsey. Onions—Silver King, White Queen, Early Red, El Paso. Cabbage—All Head, Large Flat Dutch, Early Jersey Wakefield. Kale—Scotch, Curley. Lettuce—Prize Head, Early Curled Silesian, Hanson. Radishes—All varieties ; Chartier is best. Peas—Dwarf Varieties, McLain's Blue Peter, American Wonder, Champion of England, Tom Thumb. Beans—Wax varieties, Refugee. Cauliflower—Snowball. Rohl Rabi, Salsify and Rhubarb do well.

BEST VARIETIES AND BREEDS

——FOR——

SOUTHERN WYOMING.

DICE McLAREN, M. S., AGRICULTURIST.

Southern Wyoming averages about 6,500 feet above sea level. This region is represented by the Saratoga Experiment Farm, and its efficient superintendent, John D. Parker, has greatly aided in the preparation of this article. The North Platte river flows northward through Carbon County, between the Sierra Madre and Seminoe Mountains on the west, and the Medicine Bow Range and the Laramie Plains on the east. The mountains are covered with pine and cedar forests, while quaking asp and balsam fir are found on the foot-hills. The copious winter snows melt very slowly in these forests, affording an abundance of water for the many streams which irrigate the valleys. Good hay naturally grows on the bottom lands close to the streams, but the yield is much increased by irrigation. The bench lands forming the divides between the small streams are covered with matted sage brush. This is the most fertile soil, producing heavier crops of hay, grain or vegetables than the bottom lands, but as it costs more to get the water on the bench lands, the latter are little cropped. Larger irrigating canals will soon reach them. The soil near the foothills is a clay loam,

becoming lighter towards the middle of the valleys, where it is sandy. The clay loam seems best for vegetables, but all is deep and fertile. Under the magic touch of irrigation the soil of southern Wyoming produces enormous crops.

The Green river, supplied from streams rising in the Sweetwater and Wind River Mountains, traverses Sweetwater County. This river and its tributaries afford excellent opportunities for the irrigation farmer. The Red Desert and the Bitter Creek Bad Lands are in the northwestern part. The numerous springs of the southern part afford water for the many herds which graze there. The valley of the Little Snake river is famous for its agriculture.

Southern Uinta County is a mountainous region, chiefly devoted to mining and stock-raising. This County is as large as the State of Massachusetts, Sweetwater County is larger than Vermont and Carbon County has about the area of New Jersey. The average summer temperature is about 60° F., and the annual rainfall varies from eight to fifteen inches. The chief industries are stock-raising and mining.

The Saratoga Experiment Farm represents the North Platte Valley especially. This valley is larger than the State of Delaware and is well watered, there being a running stream about every seven miles, making farm crops prolific.

From trials made on the Saratoga Experiment Farm in 1891, and from answers to circular letters sent the farmers and ranchmen of Carbon, Sweetwater and South Uinta Counties, the following varieties and breeds are recommended as adapted to Southern Wyoming: White

Russian spring wheat yields a heavy, hard grain, good for milling. Chili, Oregon Red and Velvet Chaff are other good varieties. May winter wheat and Dutch winter rye promise well. Oats yield thirty to fifty bushels per acre, and weigh forty to forty-five pounds per bushel. The varieties preferred are: Welcome, Black Spanish, Bonanza, Iowa and Side. Four-Rowed spring barley and Okshott's winter barley do well. European and common flax are successful, withstanding heavy frost. Both Japanese and Silver Hull buckwheat yield well, and the grain is very heavy and well adapted for flour. Canadian and Early Scotchman field peas produce large yields of a good grain stock feed, which, with the grains above, must supply the place of field corn, as the latter does not mature in this region. All of the above spring crops should be planted as early as the ground can be prepared. Corn fodder, sorghum fodder and millet cure very rich in this dry air. The Klein Wanzleben sugar beet yields seventeen tons per acre, and analyzes 16 per cent. of sugar. The best root crops for stock are rutabagas, carrots, sugar beets and artichokes. The popular breeds of poultry are Plymouth Rocks and Brown Leghorns for eggs.

The best tame grasses for hay are timothy, alfalfa and red-top. The best wild grasses for hay are blue stem, wild red-top and wire grass, all well irrigated. Red-top and alfalfa make good tame pasture. Maurice Groshon, of Ft. Bridger, has good timothy planted on sod and flooded. J. S. Teninger, of Ham's Fork, seeds timothy and red-top together. M. Jones, of Calf Creek, finds wild pasture improved by thorough irrigation late in the fall. J. C. Brewer, of Saratoga, finds alfalfa and timothy very profitable crops.

For twenty years cattle raising has been the principal business of Southern Wyoming. Within the last five years the cattle business has decreased in a like ratio to the increase of sheep-raising and farming. The tendency has been to improve the breed. For general purposes the Shorthorn seems to be the favorite, although the Polled Angus and the Herefords are popular. F. H. Williams, of Saratoga, finds Texans most profitable on the range, selling at three years. Harry Wood, of Ham's Fork, prefers Herefords, and sells at three and four. C. W. Holden, of Fontenelle, sells at the same age, but finds grade Shorthorns best for the range. S. L. Rhodes, of Saratoga, prefers the Aberdeen, and fattens in winter on hay and turnips. E. J. Fouts, of Saratoga, fattens his Herefords and Galloways on hay, beets and rutabagas in winter. Most of the cattle are fattened on grass. Jersey and Shorthorn are the best dairy cattle.

The profits of sheep growing are very great, and it is doubtless the most desirable business in this region. The sheep live the entire year with no other feed than what they get on the range. They are not fed, even in the hardest storms, but are watched by a herder, who lives in a covered "sheep wagon," and moves the herd from range to range. Grade Merinos and Shropshires have proved the most profitable. C. B. Sears, of Black Buttes, finds French Merinos best, selling wethers from two to four years, and ewes from six to eight. He finds alfalfa the most profitable feed for fattening mutton sheep.

Southern Wyoming is especially adapted to breeding and maturing horses. The light air and the hilly country develop sound lungs and a good hoof. Clydesdale, Norman, Percheron and Belgian are popular shipping breeds. For home use these horses are not so useful as a lighter animal. The long distances between ranches, or to the towns, make it absolutely necessary for the Wyoming ranchman to pay more attention to breeding for speed and wind than for weight and strength.

HORTICULTURE.

B. C. BUFFUM, B. S.

The following statements and recommendations were taken from and suggested by answers to Circular No. 2, data having been kindly furnished by the following persons: C. B. Sears, Black Butte; R. Brackenburg, S. G. Clark, Carbon; A. Bistorious, F. Herman, Elk Mountain; A. A. Bailey, Evanston; M. Groshon, Ft. Bridger; H. Wood, Ham's Fork; Wm. Taylor, Rock Creek; J. W. Gates, A. Kendall, P. J. Quealey, Rock Springs; H. Bridges, H. W. Haines, Jones & Williams, S. L. Rhodes, Saratoga.

J. D. Parker, Superintendent of the Saratoga Experiment Farm, writes: "In the line of fruit raising little has been done in this vicinity. Currants, gooseberries and strawberries are about all the fruits cultivated here. It is only in the last few years that any attempt has been made to raise garden vegetables." Mr. Quealey says: "The production of garden vegetables for ranch use covers the extent of our operations here in Shirley Basin, Carbon connty. The vegetable products consist principally of small garden stuff and root crops." Dr. Clark, of Carbon, states that some are experimenting with apples, and in favorable localities with considerable success. He also says: "In narrow valleys, and places sheltered by mountains, fine tomatoes, cucumbers, melons and eggplants have come to perfection."

At Rawlins, Rock Creek and Evanston no fruits have been tried and vegetables are not grown extensively. At the other places, however, a number have been tried. Currants, gooseberries, strawberries, and those fruits which

can be covered with earth for winter protection, as blackberries and raspberries, do best. Among vegetables the root crops are the most successful, though all are matured in some localities. In all elevated places care should be taken not to irrigate too much. More water than is absolutely necessary is apt to make the soil cold and retard growth.

The following varieties are recommended for planting and further trial:

FRUITS.

Apples—Russian varieties, Duchess, Wealthy, Tetofsky for trial. Crabs—Transcendent, Yellow Transparent, Hyslop, Siberian. Plums—Native varieties, Weaver. Strawberries—Wilson, Sharpless, Crescent, Jocunda. Currants—Red and White Dutch, Cherry, Fay, Black Lees. Gooseberries—Houghton, Downing, Industry. Raspberries—Turner, Cuthbert, Caroline, Mammoth Cluster, Gregg. Blackberries—Snyder, Colossal, Lawton. Grapes—Concord, Delaware, and Moore's Early for trial.

GARDEN VEGETABLES.

Beans—Wax varieties, Kidney, Navy. Peas—Bliss, Abundance, Early Stratagem, Delicious, Everbearing. Cabbage—Jersey Wakefield, Bleichfield, All Seasons, Etamps, Early York, Winningstadt. Cauliflower—Snow Ball, Henderson's Early. Celery—White Plume. Sweet Corn—Early Minnesota, Marblehead, Cory. Melons—Kolb's Gem, Glory of Asia, Boss. Onions—New White Queen, Silver Skin, Red and Yellow Danvers. Squash—Hubbard, Crookneck and White Scollop. Tomatoes—Dwarf Champion, Livingston's Perfection, Paragon. Cucumbers—Early Russian, Chicago Pickling, White Spine. Potatoes—Early: Clark's No. 1, Early Rose, Early Ohio, Chicago Market; late: Late Rose, Rural New Yorker No. 2, Beauty of Hebron. All varieties of other root crops.

BEST VARIETIES AND BREEDS

FOR

WEST-CENTRAL WYOMING.

DICE McLAREN, M. S., AGRICULTURIST.

The agricultural portions of West-Central Wyoming are the table lands, the mountain basins, and the valleys. This region is represented by the Lander Experiment Farm. The able Superintendent, Jacob S. Meyer, has given much assistance in the preparation of this article. The mountain basins range from 3,500 feet above sea level on the Big Horn river, to 5,500 feet at the heads of the Wind and Green rivers, and are surrounded by mountains from 7,000 to 13,500 feet high. Below 10,000 feet these peaks are covered with dense forests of pine, spruce and fir, and above these are the perpetual snows which supply the clear water to the many streams which irrigate the beautiful valleys of the basins.

The table-lands comprise the greater part of the arable ground, and consist of first and second benches, which vary from gently rolling prairies to broken hills, bluffs and canyons. Though not so fertile as the bottom lands of the mountain valleys, the benches produce better fruits, and all crops thrive well in the durable soil. The river bottoms have a sandy alluvial soil. The first benches have less alluvium, but more sand, gravel and clay. The second and third benches are covered with clay, sand and gravel loams. The soils are exceptionally rich in grain-

producing elements, and the continuous supply of irrigation water from the mountain streams is laden with those minerals specially useful to vegetables and cereals. A total failure of crops is unknown. The Lander Experiment Farm is mainly on the first bench of the table land, containing only a small portion of the bottom land skirting the Big PopoAgie river.

In Northwestern Wyoming is the famous Yellowstone National Park, containing the headwaters of the Yellowstone river. To the south of the Park is the upper valley of the Snake river in Northern Uinta County. The Sweetwater river flows east through a sandy valley in Southern Fremont County. Big Horn and Fremont Counties contain the great valley of the Big Horn river and its tributaries, the Stinkingwater, the Grey Bull, the Painted Rock, the Wind, and the PopoAgie rivers.

The average summer temperature is about 60° F. and the annual rainfall about twelve inches. Irrigation is necessary. The winters are generally short, with sunny days and clear nights. But little snow falls before Christmas. The air is so dry that even when the mercury falls to 40° below zero, lumbermen, freighters and hunters work and camp out doors with comfort. Two or three feet of warm snow falls in April and May, sprouting and quickening the spring crops. Heavy snowfalls in May are sure harbingers of large crops, and of good grass on the range. A snowless spring causes much labor in irrigating up the planted crops, and is generally followed by smaller yields and shorter grass on the range. The melting of the mountain snows causes river floods in June and July. Grain is harvested in August and September. A deep October snowfall presages two or three months of Indian

Summer weather. Snow lies on the ground so short a time that there is very little sleighing, and stock live outdoors all winter on the sun-cured grass.

The following varieties and breeds are recommended for West-Central Wyoming. This judgment is made from the crops grown on the Lander Experiment Farm in 1891, and from answers to circular letters sent to the farmers and ranchmen of Fremont, Big Horn and Northern Uinta counties.

Of spring wheats, the White Touse, White Club and Scotch Fyfe are grown most. A. P. Battrum, of Lander, finds it best to sow a mixture of Touse and Club. He reports a yield of White Touse of sixty bushels per acre. The usual yield is twenty-five to forty bushels per acre, of heavy, hard wheat. May winter wheat does well planted early in September. Both spring and winter rye are successful, making good stock food. The White Russian, Welcome and American Banner oats are the most popular. The yield per acre is from thirty-five to eighty bushels, weighing forty to forty-six pounds per bushel. Mr. Battrum grew seventy-two bushels per acre of Golden Giant Side oats. Chas. Wells, of Red Bank, prefers the White Siberian variety. Four and Six-Rowed barley and Okshott's winter barley are well adapted to this region, yielding from forty to sixty bushels per acre. Canada field peas do well. European and Russian flax are reported successful. Both common and Japanese buckwheat yield well. White Navy beans ripen thoroughly.

Only the hardier varieties of corn are grown in the valleys under the Continental Divide. But in the valleys of the Big Horn, Owl Creek and Stinking Water, Missouri

Dent corn matures every year, yielding sixty bushels to the acre. F. S. Wood, of Otto, finds the Early Dent successful. Sod corn on the Grey Bull river has yielded forty bushels per acre. Yellow Canada Flint makes a good fodder corn. Pride of the North and Minnesota King do well. Early Amber is the best fodder sorghum. German millet is an excellent forage plant. The best tame grasses for hay are alfalfa, timothy and red-top. John Kimpel, of Lander sows alfalfa and timothy with spring wheat. Alfalfa does well sown with oats. J. J. Frey, of Lander, seeds red-top on the snow in early spring. The blue stem and blue joint are the best wild grasses for hay. They should be thoroughly irrigated, and are often benefited by manure. The best tame grasses for pasture are red-top, alfalfa and timothy.

Rutabagas, sugar beets, carrots and artichokes are good root crops for stock. The sugar beets yield a high percentage of sugar.

Cattle do well on the range, the loss being very small. The Shorthorn and Polled Angus are popular breeds. Robert McAuley, of Atlantic City, and Otto Frame, of Arland, prefer grade Herefords for the range. J. A. McAvoy, of Lander, prefers Devons for all purposes, and fattens them in winter on alfalfa, carrots and rutabagas. The Jerseys and Shorthorns are the most popular dairy cattle. Merino and Shropshire sheep do well on the range.

Morgan and Hambletonian horses are the best for the range, and for all purpose horses. For farm horses, Normans, Clydes and Morgans are about equally popular.

Poland China and Berkshire swine do well if fed in summer on alfalfa pasture, and in winter on peas, barley and artichokes.

Nearly all farm crops are successful in this region.

HORTICULTURE.

B. C. BUFFUM, B. S.

The following persons have kindly answered and returned Circular No. 2: E. Young, Dallas; A. P. Battrum, Chas. Edwards, Mrs. M. A. Mason, J. A. McAvoy, Lander; F. S. Tweed, Otto.

J. S. Meyer, superintendent of the Lander Experiment Farm, writes as follows: "In the spring of 1882 I set out sixty apple trees. The following winter these all turned black on the side toward the west, and died down to the roots. In 1885 I again set out twenty-four trees. These did well, and were it not for the rabbits, which killed the larger part of the trees, I would at present have a nice little orchard. One of the trees sprouted out above the graft, and in five years produced one-half bushel of fruit. Excepting grapes, all small fruits do well here. Twenty-five gallons of berries were produced by my blackberry bushes this year. The bushes have to be covered with earth to protect them during the winter. I believe it is only a matter of a few years until this valley will produce its own apples and small fruits. Some kind of protection is necessary on the north and west. Apples should be set out on uplands, *i. e.*, on the first or second bench above the river."

Mr. Young, of Dallas, says: "My trees have been overloaded for two years, and have not winter-killed. I have some Russian varieties of great promise. Small fruits need winter protection."

Although but little has been done in this section as yet, the experiments which have been carried out, and are under way, prove beyond a doubt that well directed effort

in raising vegetables and fruits will be well repaid. Irrigation is necessary, except on the river bottoms. The soil is very productive, crops grow to a large size and yield heavily. From answers to the circular, the following varieties are recommended for planting and further trial :

FRUITS.

Apples—Duchess, Wealthy, St. Lawrence, Tetofsky, Ben Davis. Crabs—Transcendent, Hyslop, Whitney No. 20, Briar's Sweet. Pears—Bartlett, Crabb's Favorite. Plums—Native varieties, German Prunes, Weaver, Miner. Currants—Cherry, White Grape, Fay, Red and White Dutch, Black Lees. Gooseberries—Houghton, Industry, Downing. Raspberries—Cuthbert, Turner, Gregg, Mammoth Cluster. Blackberries—Lawton, Snyder. Strawberries—Crescent, Sharpless, Triumph, Wilson. Grapes Concord, Wilder, Moore's Early, Delaware.

GARDEN VEGETABLES.

Beans—All Wax varieties, Navy. Celery—Boston Market, White Plume, Golden Self-Blanching. Cucumbers—White Spine, Early Frame, Boston Pickling. Sweet Corn—Early Minnesota, Cory. Cabbage—Flat Dutch, Drumhead, Early Winningstadt. Onions—Red and Yellow Danvers, Red Wethersfield, Silver Skin. Melons—Kolb's Early, Cuban Queen, Ice Rind, Boss, Nutmeg. Peas—All varieties, Champion of England, Delicious, Ever Bearing. Potatoes—early, Clark's No. 1, Early Ohio, Early Minnesota ; late, Mammoth Pearl, Blue Victor, Iron Clad, Invincible. Squash—Hubbard, Bush Crookneck, White Scollop. Tomatoes—Dwarf Champion, Paragon. Peppers and Egg Plants do well if started early in hot bed. Lettuce and Root Crops—All varieties grow well; no recommendation of best varieties are made.

BEST VARIETIES AND BREEDS

—FOR—

EASTERN WYOMING.

DICE McLAREN, M. S., AGRICULTURIST.

The agricultural portions of Eastern Wyoming vary from 4,000 to 6,000 feet above sea level. This part of the State is represented by the Wheatland Experiment Farm. The capable superintendent, Martin R. Johnston, has assisted in writing this article. The portion of Wyoming here described comprises Laramie and Converse Counties. The general surface is a rolling prairie, interspersed with river and creek valleys, with extensive level divides between. It is a continuation of the Great Plains country of Western Nebraska and Kansas, with many of its characteristics. To the west is the Laramie Range, the first great foot-hills of the Rocky Mountains. To the northeast the land rises toward the Black Hills. Between these elevations the North Platte river flows southeast through the middle of this region, receiving, near the center, the Laramie river, which waters the Laramie Plains to the west and above the Laramie Range.

The climate is temperate and healthful. The average summer temperature is about 60° F. The annual rainfall is about fourteen inches. The spring rains are sufficient to start all crops, but summer irrigation is necessary. The nights are cool, with frosts till the middle of May, but the summer is warm. Killing frosts occur about

October 1st. The soil is very fertile. Red and black sandy loams predominate.

Pine trees are found on the summit of the Laramie Range, quaking aspen and cedar lower down, and narrow-leaved cottonwood, box elder and broad-leaved cottonwood along the prairie streams. The prairies are covered with nutritious blue stem, grama, buffalo and bunch grasses. This region is a famous grazing country, being well watered by the never-failing streams, which rise in the many springs of the Laramie Range. The warm, long summer renders it an excellent agricultural region.

Experiments tried on the Wheatland Experiment Farm in 1891, and answers to circular letters sent to farmers and ranchmen of Laramie and Converse Counties, are the basis for recommending the following varieties of farm crops and breeds of stock, as adapted to Eastern Wyoming :

The Ruby, the White Russian and the Italian varieties of spring wheat have proved successful. Plant in April, or earlier, if the ground can be prepared. A. A. Spaugh, of Manville, raises the Italian spring wheat. The Fultz and Slosson winter wheats have proved best. Plant in August or September, and best in drills which shelter the young plants from the dry winter winds. The usual yield of wheat is from twenty to forty bushels per acre. Salter's spring rye and German winter rye do well, the latter furnishing good fall pasture. Oats yield especially well, the White Russian, White Swedish and American Wonder being preferred. Colin Macdougall, of Bordeaux, prefers the Mane oats, planting in April. Oats planted late in the fall remain dry in the ground, ready to be sprouted by the earliest spring rains. Both Four and

Six-Rowed barley are successful. Okshott's winter barley is worthy of trial. Both European and common flax do well, as would be expected from the luxuriance of the wild flax. Japanese and Silver Hull buckwheat are good varieties. Canada field peas yield heavy crops of grain. The White Lima and White Navy beans produce profitable crops.

Field corn matures well, the grain and fodder being the best fattening food for stock. The earlier varieties should be planted, as, Angel of Midnight, Early Mastodon Pride of the North and Whitley Dent. Corn should be planted about the middle of May. The white and yellow Dent and the white Ensilage are the best varieties for corn fodder. Duncan Grant, of Two Bar, has successfully raised Kaffir corn and Millo maize for fodder. Early Amber sorghum is one of the best plants for fodder. German millet is a deservedly popular forage plant in this region.

The best tame grasses for hay are alfalfa, timothy and red-top. Alfalfa does well sown with oats, in April. The oats yield a good crop, and the stubble protects the young clover during the winter. After the first year three crops may be cut each season, making the annual yield from six to nine tons of nutritious hay. W. F. Macfarlane, of Glendo, finds that timothy does well planted on sod, in April. Red-top is reported as succeeding when treated in this manner.

The best wild grasses for hay are blue stem and grama, well irrigated. The best tame grasses for pasture are red clover and alfalfa. The best wild grasses for pasture are the grama, blue stem and buffalo.

Among the root crops which can be successfully

raised for stock are rutabagas, sugar beets, mangolds, carrots and artichokes. The Improved Vilmorin sugar beet has yielded seven tons of beets, analyzing 23 per cent. of sugar. Much larger yields are reported having a good percentage of sugar.

Stock-growing is the great industry of Eastern Wyoming. The excellent summer pasture develops and fattens the stock at little expense. On this natural-cured hay the stock pasture through the winter, being fed in the worst storms. The most popular breed of cattle is the Hereford. John Steele, of Hat Creek, finds that these sell well at two years. Patrick Mullin, of Uva, prefers grade Shorthorns, selling from three to four years. W. A. Watrous, of Wheatland, writes that the Devons mature early, fatten easily and are prolific breeders. Crossed with the Shorthorn he considers them the best for all purpose cattle. Holsteins and Shorthorns are considered the best cattle for dairy purposes.

For both range and pasture sheep, the Merino and Shropshire take the lead.

The Norman horses are most popular for the range, though the lighter breeds are much raised. Normans and Clydes are the best farm horses. Chester White and Poland China swine do well fed in summer on alfalfa, and in winter on corn and cooked roots.

As the range is becoming overcrowded, it is found more and more difficult to fatten stock for market on grass. Formerly the cattle could get enough of the rich grass seeds of the blue stem and oryzopsis to fatten them. This now needs to be supplied by some grain feed. Though many cattle are driven to the corn fields of Nebraska for fattening, it will probably pay better to fatten at home on corn and corn fodder, roots, chopped grain and alfalfa and blue stem hay.

HORTICULTURE.

B. C. BUFFUM, B. S.

Answers to Circular No. 2 have been kindly returned by the following persons: C. Macdougall, Bordeaux; Al Bowie, F. E. Ferguson, Wm. Taylor, Chugwater; John Storrel, Douglas; S. Doty, F. Knadt, Ft. Laramie; W. F. Macfarlane, John Moran, Glendo; W. A. Briney, Glenrock; Davidson Bros., Iron Mountain; M. J. Goodwin, Lusk; J. N. Blackwell, S. J. Hedrick, Lakeview; C. J. McLaughlin, Orin Junction; J. H. Gordon, South Bend; Duncan Grant, Two Bar; P. Mullin, Uva; M. R. Johnston, R. Nelson, W. A. Watrous, Wheatland.

As is true in all parts of the State, a large portion of this section is covered with scattered ranches, and until recently little or no attention has been given to raising fruits. Experiments which have been made indicate that no small degree of success with fruits and vegetables will follow where the proper cultivation and care are given.

Mr. Gordon writes: "I am fully persuaded that all fruits which can be grown in Northern Colorado can be grown in this section, provided the same care and attention is given." At the Wheatland Experiment Farm, in addition to the more hardy crops, tomatoes, and even peanuts, have been successfully raised. Mr. Lusk, at Lusk, has a number of varieties of apples which are doing nicely, and small fruits succeed well. In addition to the usual rules for planting and cultivating fruits, the following are suggested: 1. Late in the fall irrigate all fruits thoroughly to prevent their drying out during the winter. 2. Mulch all trees for winter, taking care not to let the mulch lie

directly against the bark of the tree. 3. Cover the tender shrubs, as raspberries, blackberries and grapes, with earth, for winter protection. Mulch strawberries.

The following varieties are recommended :

FRUITS.

Apples—Ben Davis, Wealthy, St. Lawrence, Wine Sap, Pennock, Duchess, Tetofsky. Crabs—Transcendent, Briar's Sweet, Siberian. Pears—Bartlett, Clapp's Favorite. Plums—Weaver, Native varieties. Cherries—Ostheim. Currants—Red and White Dutch, Cherry, White Grape, Fay, Black Lees. Gooseberries—Houghton, Industry, Smith. Raspberries—red, Turner, Cuthbert; yellow, Caroline; black, Gregg, Mammoth Cluster. Blackberries—Snyder, Wilson, Lawton, Early King. Strawberries—Crescent Seedling, Sharpless, Bubach, Iron Clad. Grapes—Moore's Early, Concord, Wilder.

GARDEN VEGETABLES.

Beans—Wax varieties, White, Marrow, Early Mohawk. Peas—Telephone, American Wonder, Champion of England, Delicious. Celery—White Plume. Cabbage—Drumhead, Flat Dutch, Early Winningstadt. Cauliflower—Snowball. Sweet Corn—Cory, Early Minnesota. Melons—Glory of Asia, Kolb's Gem, Ice Rind. Onions—Yellow Danvers, Silver King, New Queen, White Russian. Squash—Hubbard, Durlap's Prolific, Marrow. Summer. Tomatoes—Dwarf Champion, Livingston's Perfection. Potatoes—early, Clark's No. 1, Rose Reedling, Early Maine ; late, Mammoth Pearl, White Elephant, Charles Downing, Blue Victor. Beauty of Hebron. Peppers and Egg Plants do well if started early. Root crops and lettuce, all varieties.

BEST VARIETIES AND BREEDS

——FOR——

NORTHEASTERN WYOMING.

DICE McLAREN, M. S., AGRICULTURIST.

Northeastern Wyoming is from 4,000 to 5,000 feet above sea level. Agricultural experiments for this region are tried on the Sundance Experiment Farm. The energetic Superintendent, Thomas A. Dunn, has written the descriptive portions of this article. The surface of Crook and Weston counties is diversified. To the east are the wooded elevations of the Black Hills. To the west is a prairie country whose low hills are sparsely covered with pines. This entire Black Hills region is drained on the south by the Cheyenne river and on the north by the Belle Fourche, with their numerous tributaries. The eastern foot-hills are covered with superior pine timber. The wash from the mountain sides makes the soil of the mountain parks and valleys very fertile. This constitutes the black loam of the mesas or mountain table lands. At the base of the mesas are found the fertile red gypsum soils. To the west and south is found the rich loamy soil of the sage brush lands. Artificial irrigation is necessary only in the regions with sage brush land. This soil is well adapted to grain and sugar beets. The gypsum in the red soils so well retains the moisture of the spring rains that crops grow freely throughout the summer. This soil is similar to that of the famous Rhine valley. The black loams are similar to those of the Mississippi valley, being

equally productive. They are formed by adding decomposed vegetable matter to the red soils, and in this are similar to the prairie soils of the Great Plains, being equally able to withstand drouth.

The average summer temperature is 60° F., and the annual rainfall is about 17 inches. Most of the rain falls in spring and early summer, the autumn being dry. The growing season is long enough to mature corn and all small grains. The sunshine of the many bright days develops all crops, and adds much to the success of the farmer.

Pine, burr-oak and white elm suitable for lumber and fuel grow on the hills. Along the streams and the canyons are found black and white spruce, white birch, box-elder, broad-leaved cottonwood and willow. Wild fruits are abundant. The soil of the Sundance Experiment Farm is fairly typical of the soils of Crook and Weston Counties, being a red gypsum largely washed from surrounding hills. As it is similar to the valley land of these counties, it is well adapted to represent the different phases of farming in Northeastern Wyoming. As irrigation is not general in this region, it will not be practiced on the Farm.

The following varieties of farm crops and breeds of stock are recommended as adapted to Northeastern Wyoming. This selection is based on the Sundance Experiment Farm trials of 1891, and on answers to circular letters sent to the farmers of Crook and Weston Counties.

Yields of upwards of fifty-five bushels per acre of spring wheat are not infrequent. The best varieties are Improved Fyfe, Niagara and Red Oregon. S. H. C. Kent, of Carlile, has good success with Red Chaff. May and Fultz winter wheats promise well. H. C. Manken, of

Eothen, finds the Wild Goose spring rye very successful. Black winter rye yields well and furnishes good fall pasture. John Pearson, of Eothen, reports a yield of 41 bushels per acre. He writes that if sown any time during the fall or winter it will head the next summer, but if sown in the spring it furnishes only pasture the first year. Oats have yielded 100 bushels per acre. The most popular varieties are Welcome, American Banner, White Russian and Siberian. DeSoto E. Richardson, of Sundance, has good success with the Mammoth, planted in April. E. L. Burke, of the Devil's Tower, cuts his oats for fodder and reports a yield of four tons per acre. Six rowed spring barley is successful. Wm. Van Gundy, of Inyan Kara, reports Okshott's winter barley as doing well, planted August 15th. European and Russian are the best varieties of flax. Japanese buckwheat is a good crop. Canada Golden Vine field peas yield well. Thomas P. Sweet, of Newcastle, reports good success with Alaska field peas planted in April. White Navy beans are the best for a field crop.

The successful raising of field corn is a certainty, and the yields compare favorably with some of the famous corn belts. Flint, Yellow Dent, Pride of the North, Squaw and Mandan are the preferred varieties. F. J. C. Mackenzie, of Sundance, plants his Flint corn at the budding of the oaks. The Dent varieties are the best for fodder. Early Amber and Kaffir sorghum, and German and African millets are also good for fodder.

The best tame grasses for hay are timothy, alfalfa, red clover, orchard and Johnson grasses. Ward Brown, of Forks, reports good success with orchard grass planted in April. The best wild grasses for hay are blue joint,

blue stem, grama, and wheat grasses. The most popular tame grasses for pasture are timothy and clover, and Johnson grass. Of the wild grasses, buffalo, blue joint and grama furnish the best pasture. Among the good root crops for stock are rutabagas, sugar beets, mangolds, carrots and turnips. L. M. Hulett, of Hulett, reports carrots as doing well. The Simon La Grande sugar beet yielded six tons of beets analyzing 20 per cent. of sugar.

Stock raising is an important industry. The dry falls cure the nutritious grasses on the ground for use in winter range and pasture feeding. Grade Hereford, Shorthorn and Polled Angus are the most popular breeds of cattle. S. A. Young, of Inyan Kara, raises Herefords, selling at four years old. John G. Bunney, of Forks, prefers grade Herefords and sells at four years. Holstein, Jersey, Roan Hereford and Ayreshire cattle are used for dairy purposes. For range sheep, Southdown and Merinos are preferred. Shropshires do well in pastures.

Morgan and Norman norses are popular. Burke and Mackenzie, of the Currycomb Ranch, write: "Our mares are mostly well graded western stock. We are breeding them to imported Suffolk stallions. Our imported Suffolk mares required very little feeding last winter and appear to take kindly to range life in this climate." LeRoy G. Hoyt, of Beulah, has good success with American horses. Berkshire and Poland China swine do well fed in summer on alfalfa pasture and artichokes, and in winter on corn and chopped feed. A. D. Brown, of Forks, feeds cooked sugar beets to his Berkshires. Leghorn and Plymouth Rock hens, Bronze turkeys, ducks and geese are profitable. Farming in Northeastern Wyoming has been demonstrated a success.

HORTICULTURE.

B. C. BUFFUM, B. S.

The following persons in Crook and Weston Counties have kindly answered and returned Circular No. 2: C. C. Ripley, Beulah; John Parsons, Eothen; E. C. Hall, Gillette; J. P. Bush, L. M. Hulett, Hulett; Wm. Van Gundy, S. A. Young, Inyan Kara; Thos. P. Sweet, New-castle; J. H. Baxter, Riverdale; J. A. Banguess, F. C. Mackenzie, D. E. Richardson, R. H. Williams, Sundance.

In speaking of fruits, Mr. Williams writes: "Apples and crabs seem to be doing well, also dewberries and grapes. There are wet places in the hills where the cranberry grows well. Raspberries, currants and gooseberries are successful, but blackberries I have no faith in, unless special care is taken, as the canes freeze down every winter." Others have made the same complaint. There is but one remedy, *i. e.*, winter protection. To successfully raise raspberries, blackberries and grapes, in nearly all parts of the State they must be bent to the ground and covered with earth in the fall for protection through the winter.

From the experiments made with fruits, the outlook is very promising. The soil is unusually productive, vegetables of great size being reported. Thos. A. Dunn, superintendent of the Sundance Experiment Farm, says: "A proof of the adaptability of this section to anything in the vegetable line is found in the fact that the sweet potato has been raised successfully in several parts of Crook County.

While irrigation is not always necessary, it is beneficial. Mr. E. Hall writes: "The use of water makes an astonishing change in the growth and vigor of all crops.

The most unpromising soil will yield without stint upon the application of water."

From the answers given to the circular the following varieties are recommended :

FRUITS.

Apples—Wealthy, Ben Davis, Bailey's Sweet, Jonathan, Duchess, Tetofsky. Crabs—Transcendent, Siberian, Hyslop, General Grant. Plums—Native varieties from seed, Pond's Seedling Prunes. Cherries—Richmond, Ostheim. Currants—Cherry, White Grape, Red and White Dutch, Lees Black. Gooseberries—Houghton, Industry, Smith. Strawberries—All standard varieties, Wilson, Sharpless, Vick. Raspberries—Turner, Cuthbert, Caroline, Shaffer's, Gregg. Blackberries—Snyder, Wilson, Kittanning. Grapes — Massasoit, Wilder, Delaware, Brighton, Concord.

GARDEN VEGETABLES.

Beans—Early and Wax varieties, Navy. Cabbage—Early Drumhead, Early Jersey Wakefield, Early Winningstadt, Early York. Melons—Kolb's Gem, Ice Rind, Nutmeg. Peas—Vick's Early, Champion of England, Yorkshire. Onions—Extra Early Red, Extra Early Adriatic, Red Wethersfield, Silver Skin. Squash—Hubbard, Marblehead, Pike's Peak, Summer. Celery—White Plume, Golden Self-Blanching. Sweet Corn—Cory. Tomatoes — Dwarf Champion, Livingstone's Perfection. Potatoes—early, Early Rose, Early Ohio, Clark's No. 1, Telephone ; late, Beauty of Hebron, White Peerless, Northern Spy, May Flower, Mammoth Pearl, Blue Victor. Lettuce—Hanson, Early Curled Silesian, Prize Head. Radishes—Chartier, Black Spanish Winter. Other root crops—All varieties. Cauliflower, peppers and egg plants do well ; start early in hot bed.

BEST VARIETIES AND BREEDS

FOR

NORTHERN WYOMING.

DICE McLAREN, M. S., AGRICULTURIST.

Northern Wyoming is about 4,000 feet above the level of the sea. The fertile valleys of the Tongue and Powder rivers are represented by the Sheridan Experiment Farm. The efficient superintendent, James A. Becker, has written the descriptive portion of this article. The western part of Sheridan and Johnson Counties is crossed by the Big Horn Mountains. At the foot of the eastern slope, in the fertile valleys of the many mountain streams, lies one of the best agricultural regions of Wyoming. As the distance from the mountains increases, the country becomes more rugged, merging into the Bad Lands. Barely more than the narrow valleys is at present cultivated, but with the extensive ditches now being constructed, a large portion of the fertile hills and divides will be farmed. The soil of the valleys is usually a dark, sandy loam, unexcelled in fertility. On the uplands the soil is usually of a lighter color, sometimes consisting of a coarse gravel or a yellowish gumbo clay.

The climate is peculiar, differing greatly within a few miles. The average summer temperature is about 65° F. The rainfall is light, except near the mountains. About twelve inches of rain falls yearly, mostly in the early summer. Summer irrigation is necessary. The atmosphere is dry and invigorating. Northwest winds prevail. There

are sudden changes of weather and local hail storms near the mountains.

The principal forest trees are broad-leaved cottonwood, box-elder, ash and willow. Wild cherry and plum, and chaparelle or buffalo berry, grow in the valleys.

In 1891 sugar beets yielded 10.7 tons per acre, analyzing 18 per cent. of sugar. This yield per acre can be easily doubled without loss in sugar content. Sorghum promises well. Early corn matures well.

The fertility of soil is unsurpassed, the crops of roots and grains being enormous. In 1890 W. A. Sturgis, of Buffalo, harvested 974 bushels and forty-eight pounds of potatoes from a measured acre. In 1891 S. D. Hays, of Big Horn, on part of an acre grew a yield of potatoes equal to 975 bushels per acre. These gentlemen won the 1890 and 1891 prizes offered by the *American Agriculturist* for the largest potato yield in America. John Blake, of Beckton, has raised 126 bushels of oats per acre. T. R. Dana, of Pass Creek, has harvested sixty bushels of wheat per acre.

Winter wheat has been grown successfully, but the millers claim the kernels are too soft to make good flour. It is a surer crop than spring wheat in dry years, as it matures before the snow on the mountains is melted. As it requires less irrigation, and furnishes good fall pasture, the Sheridan Experiment Farm will make trials of hard winter wheats.

From trials in 1891 on the Sheridan Experiment Farm, and from answers to circular letters sent the farmers of Sheridan and Johnson Counties, the following varieties of farm crops and breeds of stock are recommended as adapted to Northern Wyoming :

The best varieties of spring wheat are Scotch Fyfe, Sawatchkan, Reliance, Club and Amber. Alfred A. Lambrigger, of Big Horn, reports a yield of eighty-eight bushels per acre of Amber spring wheat. George Ohlman, of Ohlman, has good yields of May winter wheat planted in September. The Giant and the Dutch spring rye are reported successful. Winter rye makes good fall pasture, and yields enormously. The preferred varieties of oats are White Russian, Welcome, White Dutch, Early Dakota and Black Tartarian. L. B. Dewey, of Banner, prefers the Welcome. Brewer's Two and Four-Rowed and Manshury spring barley yield a heavy crop of bright curing grain. Okshott's winter barley promises well.

Where wild flax flourishes so well, the European and common varieties should succeed. Japanese and Silver Hull buckwheat are the best. J. M. Works, of Sheridan, reports good success with Canada Marrowfat and Morning Star field peas. White Navy and Bush Lima are reported the best field beans.

Field corn matures well. The preferred varieties are: Yellow Dent, Wyoming, Ninety-Day, Mandan and Squaw. Joe Harper, of Banner, plants Yellow Dent and Ninety-Day on May 1st. Dent, Squaw and Sweet corn are recommended for fodder. Early Amber sorghum and German millet make good fodder. The best grasses for tame hay are: Alfalfa, Timothy, Red Clover and Orchard Grass. H. W. Davis, of Powder river, planted alfalfa with oats. The oats yielded even better than usual, and the alfalfa did as well as that planted alone. Alfalfa can be winter-killed by late pasturing or irrigating. The best wild hay is blue stem and blue joint. The best tame pasture is alfalfa and timothy. The successful root crops

for stock are: Rutabagas, sugar beets, mangolds and carrots.

The Shorthorns and Herefords are preferred for range cattle. H. W. Davis, of Powder river, writes: "I have had several years experience with the Sussex cattle, and believe that for our short grass, and other conditions, this is the best breed." Luke Voorhees, of the same place, has found the West Highlands well adapted to range purposes.

The Jerseys, Shorthorns, Holsteins and Ayreshires are preferred for the dairy. J. F. Brown, of Landgrove, a dairy farmer of twenty-five years' experience, finds the best all-purpose cow in a cross between the Jersey and the good milking strains of Shorthorn.

Merino and Southdown sheep are preferred for the range. The Oxfords do well in pastures. John A. Moore, of Dayton, raises Southdowns, and sells wethers at three years. The Percheron, Coach and Hackney horses are much raised. Dr. E. H. Huson, of Stone Ranch, crosses these with the Hambletonian and Morgan, gaining thereby endurance and speed. The last two breeds are deservedly popular. Berkshire and Red Jersey swine are fed in summer on alfalfa, and in winter on chopped corn. Plymouth Rock and Leghorn fowls, Angora goats and Spanish and California mules are reported successful.

As the shipping facilities of this region have been limited, the crops have been confined to those products demanded for home consumption. With the development of manufactures, and the advent of the railroad, new lines of agriculture will be pursued. The frontier farming already done gives sure promise of great agricultural possibilities for Northern Wyoming.

HORTICULTURE.

B. C. BUFFUM, B. S.

The following persons have kindly filled out and returned Circular No. 2: Joe Harper, F. Newcomer, J. Terill, Banner; Wm. Brown, E. Hurlbut, C. H. Manning, Big Horn; H. O. Hutton, Buffalo; A. Yonkee, Pass; H. W. Davis, Powder river; J. D. Loucks, John McCormick, M. L. Sawin, J. M. Works, Sheridan; Harris, Smith & Co., Trabing.

In this part of the State the soil is of many varieties, and has been proven wonderfully productive in the cereals and root crops. Considerable progress has also been made in fruit-raising. J. A. Becker, superintendent of the Sheridan Experiment Farm, writes: "Most of the small fruits have been successfully grown here. It is probable that only the more hardy varieties of large fruits will stand the climate." To insure success in this region, the following suggestions are made, in addition to the usual cultivation: 1. Mulch all trees in the fall, taking care not to let the mulch lie directly against the body of the tree. 2. Thoroughly soak the ground occupied by fruits late in the fall, so they will not dry out through the winter. 3. Tender shrubs and vines, as blackberries, raspberries and grapes, should be bent to the ground, and enough earth thrown on to thoroughly cover them, for winter protection. Do not uncover until spring is fairly opened.

From answers to the circular, the following varieties are recommended for planting and further trial:

FRUITS.

Apples—summer and fall, Duchess, Red Astrachan,

Early Harvest; winter, Ben Davis, Turner; Wolf River is promising. Crabs—Transcendent, Siberian; worthy of further trial—General Grant, Shields, Hyslop, Briar's Sweet, Montreal. Pears—As yet none are bearing; Bartlett, Clapp's Favorite, Flemish Beauty. Plums—Weaver; Miner are promising; the native wild plum is worthy of cultivation. Cherries—As a rule are not successful; Richmond, Ostheim. Currants—Red and White Dutch, Red Cherry, Lees Black, White Grape, Fay. Gooseberries—Houghton, Downing, Industry. Strawberries—Wilson, Crescent, Sharpless, standard varieties. Raspberries—red, Turner, Cuthbert; black, Mammoth Cluster, Gregg. Blackberries—Wilson, Lawton, Snyder. Grapes—Moore's Early, Concord, Martha Washington. Dewberries—Lucretia.

GARDEN VEGETABLES.

Beans—All wax varieties, Navy, Kidney, Tree Prolific. Cabbage—Flat Dutch, Drumhead, Winningstadt, Jersey Wakefield, Early York, Early Etamps, Express. Celery—White Plume, Crawford's Half Dwarf, Golden Self-Blanching. Melons—Ice Rind, Cuban Queen, Kolb's Gem, Vick's Early, Boss. Onions—Red and Yellow Danvers, Extra Early Red, Red Wethersfield. Peas—American Wonder, Bliss, Champion of England, Delicious. Potatoes—early, Clark's No. 1, Early Rose, Early Ohio, Early Snowflake; late, Mammoth Pearl, Burbank, Blue Victor, White Elephant, Beauty of Hebron. Other root crops—All varieties. Squash—Hubbard, Marblehead, Brazil Sugar; Crookneck and White Scallop for summer. Tomatoes—Dwarf Champion, Livingstone's Perfection, Paragon. Peppers and Egg Plants must be started early in hot beds.

HORTICULTURE IN WYOMING.

The conditions are so varied that it becomes difficult to recommend varieties for the whole State. The amount of land planted in fruits in the northern part of the State is variously estimated at from five to forty acres; eastern part, ten to twenty-five acres, and in the southern and western parts, from five to twenty acres. Taking the largest estimates, there are not more than eighty-five acres planted with fruits of any kind in the State. The orchards are all young, the most of them just beginning to bear. The attempts at fruit-raising, therefore, are as yet in their infancy. While many trees are, to all appearances, hardy and successful, we should guard against reaching conclusions too hastily, as only years of trial will prove or disprove the adaptability of the larger number of varieties. The success already attained is encouraging, and should cause larger and more varied experiments. With the Experiment Stations to lead in the work, the people have every advantage, with but little risk. One caution is necessary: *Buy only western grown trees.*

Planting small fruits is a safe investment in all parts of the State, providing the proper amount of care is given. All varieties of currants, gooseberries and strawberries, and the more hardy varieties of raspberries, blackberries and grapes, will succeed. We are not prepared as yet to say which one of each will do best.

Among garden vegetables, all root crops and early varieties of cabbage are unusually successful. The favorite varieties of early potatoes are: Clark's No. 1, Early Ohio and Early Rose; late—Mammoth Pearl, Blue Victor, Beauty of Hebron and Late Rose. Celery is worthy of more extended trial. White Plume and Crawford's Half Dwarf are the favorite varieties.

Best Farm Crops and Stock for Wyoming.

The Wyoming Agricultural Experiment Station recommends the following farm crops and stock for Wyoming. *N* means for the North, *S* for the South :

Spring Wheat—Fyfe, Touse, Russian, Oregon, Chili, Club *N*, Amber *N*.

Spring Rye—Salter's, Wild Goose, Giant, Dutch.

Winter Rye—Black, German.

Oats—Welcome, Russian, Banner, Tartar, Siberian, Side.

Barley—Two, Four and Six-Rowed, Manshury, Okshott's Winter.

Buckwheat—Japanese, Silver Hull.

Flax—European, Russian, Common.

Field Peas—Early Scotchman, Canada Marrowfat, Alaska.

Field Corn—Flint *N*, Minnesota King *N*, Pride of North *N*, Mandan *N*, Ninety-Day *N*.

Fodder Corn—Yellow Dent, White Dent, Flint, Sweet.

Fodder Sorghum—Early Amber, Kaffir, Jerusalem, Dhoura, Millet.

Tame Hay—Timothy *S*, Alfalfa, Red-Top, Orchard Grass *N*.

Tame Pasture—Alfalfa, Timothy, Red Top, Red Clover *N*.

Wild Hay—Blue Stem, Grama Grass, Blue Joint *N*.

Root Crops for Stock—Rutabagas, Sugar Beets, Carrots, Artichokes.

Beets for Sugar—Klein Wanzleben, Improved Vilmorin, Simon La Grande.

Range Sheep—Merinos, Shropshires, Southdowns.

Pasture Sheep—Merinos, Southdowns, Oxfords.

Swine—Poland China, Berkshire, Red Jersey.

Poultry—Leghorn, Plymouth Rock and Game Fowl. Bronze Turkeys.

Goats—Angora, Cashmere.

Mules—Spanish, California.

Farm Horses—Clyde, Norman, Morgan.

Range Horses—Morgan, Hambletonian, Coach, Suffolk.

Range Cattle—Hereford, Shorthorn, Galloway, West Highland.

Pasture Cattle—Shorthorn, Hereford, Devon, Sussex.

Dairy Cattle—Shorthorn, Jersey, Holstein, Ayreshire.

Plow ground in fall, to be pulverized by frost, and settled for early planting. Shelter young crops in drill furrows at right angles to prevailing winds. Do not waste irrigation water by wetting the deep sub-soil. Drain off all dissolved alkali. Do not drown plants in mud, but give the roots air in a moist, mellow soil. Cultivation saves irrigation. Kill foul weeds everywhere. Ripen crops before frost by stopping irrigation early. Air-dry all grasses and forage plants for stock food. Breed only from the plant or animal that is most adapted to Wyoming conditions. Well selected and maintained home varieties and home breeds are best.

From C. H. Shinn,
Univ. of Cal., by exchange Dep.
Nov. 1901.

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UNIVERSITY OF WYOMING.

Agricultural College Department.

WYOMING EXPERIMENT STATION,

LARAMIE, WYOMING.

BULLETIN NO. 6.

MAY, 1892.

Soils of the Agricultural Experiment Farms.

BY THE GEOLOGIST AND THE ASSISTANT CHEMIST.

This Bulletin is prepared from soils on the Station Farms at Lander, Laramie, Saratoga, Sheridan, Sundance and Wheatland.

Bulletins will be sent free upon request. Address: Dieector Experiment Station, Laramie, Wyo.

WYOMING
Agricultural Experiment Station.

UNIVERSITY OF WYOMING.

PRESIDENT OF THE UNIVERSITY OF WYOMING.

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The Soils of the Agricultural Experiment Farms.

RELATIONS OF GEOLOGY AND CHEMISTRY TO AGRICULTURE.

BY J. D. CONLEY.

One object of this Bulletin is to awaken an interest among our farmers in the work of the Wyoming Experiment Stations, and to enlist their co-operation in the good work begun by our liberal government for the general welfare of all interested, directly or indirectly, in agriculture.

We hope to give some general hints and information by which the home-seeker can select land that will, under fair management, yield fruitful returns to the husbandman. Our suggestions as to the sampling of soils, taken from that pioneer and authority on such work, Prof. E. L. Hilgard, of California, we trust will be of practical value to the home-seeker or farmer.

We further expect, and invite the co-operation of ranchmen and others interested in the development of our commonwealth to assist us in securing soil and other economic products from different sections of the State for exhibition at the World's Fair, to be held at Chicago in 1893. We give directions for taking and shipping samples on the last page of this Bulletin, inviting the closest conformation to the directions, hoping that we will receive the co-operation of enough loyal citizens to enable us to

The precipitation is given by months in the table on precipitation, and this occasion is taken to thank the above observers for the data furnished. It is hoped a few more observers may be obtained early in 1893, as such records from different points in the State are of great value in the study of growing crops, our pasture lands and irrigation. It is only by a series of such observations through a number of years that many questions of importance may be settled and a definite knowledge of the water supply and its distribution obtained.

Records of the amount of sunshine have been taken at each of the Experiment Farms. It has been impossible to make the necessary computations in time to report results in this Bulletin.

EXPLANATION OF TABLES. — Temperature. — The mean temperature is given from the maximum or highest and the minimum or lowest temperature for each day, the daily range being the difference between these two readings. In the relative humidity or per cent. of saturation and dew point tables the computations are made from readings of the sling psychrometer, which gives the dry and wet bulb temperatures. They have been computed from the tables in Report of the Chief Signal Observer for 1886, except where the differences between the wet and dry bulb are greater than those given, in which instances the tables of Guyot have been used, correcting for altitude in each case. The relative humidity is the per cent. of moisture in the air, taking the whole amount the air could hold at the time of the observation, or complete saturation, as 100. The dew point is the temperature at which this moisture would be precipitated should the air be cooled to that point. The atmospheric pressure or barometer readings are corrected for temperature from Guyot's tables, each reading being reduced to 32 F. The terrestrial radiation or amount of heat the earth loses during the night is given from the difference in the reading of the terrestrial thermometer, placed six inches above the ground, and the minimum thermometer. It will be noticed

that it sometimes occurs that it is warmer near the ground than the minimum temperature. This usually happens on cloudy nights, or when the terrestrial has been covered with snow, when little or no heat is lost by the earth.

The soil temperatures are from readings of the soil thermometers taken twice daily, at 7 A. M. 7 P. M. These are located on the lawn at the University, and give the temperature in irrigated ground. The air temperature given in this table is from 7 A. M. and 7 P. M. readings. In all the tables figures printed in bold faced type give the highest or lowest readings for each month.

LARAMIE.

The weather at Laramie in 1892 differs greatly in some repects from that in 1891. Although the spring was cold and backward, in April the mean temperature being 5.0°, in May 10.1° and in June 2.7° below the temperature for the same months in 1891, the season has been quite favorable to the growth of crops. The mean temperature for the year is a little below that for last year, but the months of July, August and September are notably warmer and frosts did not occur so late or early as last season. The total precipitation is over an inch less than in 1891, but the present season over one-half the amount fell in May, June and July. This, followed by the warmth of July and August, caused the grass on the range and hay crops to be better than in previous years and brought farm crops to early maturity. We have had a large amount of wind during the year, but for July, August, September and October there was much less than for the same time last season.

The coldest weather in January was only of short duration, while the highest temperature, only reaching 86°, is never oppressive. During the year there were two notable storms. June 4th and 5th a heavy snow fell

to a depth of about two feet, giving 3.31 inches of melted snow. The snow melted rapidly, going off in a few days. The large amount of water broke some irrigating canals and did damage on the Experiment Farm by washing out portions of the crops. On October 11th and 12th a heavy snow storm occurred. Twenty and one-half inches of snow fell, which gave 3.90 inches of melted snow. The snow was damp and heavy, the first falling melting as it came. A strong northwest wind caused large drifts, delaying trains, and as it turned cold after the storm the snow did not go off rapidly, causing some injury to stock.

Hail fell on May 2nd and 4th, but not to do any damage. But few thunder storms were observed. On July 16th lightning struck the Agricultural College barn, doing slight damage. For further information see tables and summary.

EVAPORATION.

The evaporation is not regularly observed during the winter months. It is measured from a water surface, as no arrangements have yet been made to observe the evaporation from soils. The last observation in 1891 was taken November 11th. Between this time and the date of the first observation this year, May 24th, the apparent evaporation was 9.69 inches. This is subject to considerable error, probably being too small.

May 24 to 31	1.59 inches
June	8.23 inches
July	9.19 inches
August	8.27 inches
September	6.10 inches
October 1 to 10	1.50 inches

Table I.

TEMPERATURE, 1892.

Date.	JANUARY. 7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.	FEBRUARY. 7 a.m.	7.p.m.	Mean.	Max.	Min.	Daily Range.	MARCH. 7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.
1	12.5	14.7	8.6	21.3	−4.0	25.3	19.5	25.0	24.4	32.3	16.5	15.8	31.5	36.0	39.5	49.0	30.0	19.0
2	24.2	32.8	23.0	35.0	11.0	24.0	24.5	22.8	28.0	35.0	21.0	14.0	32.5	34.5	38.5	47.0	30.0	17.0
3	27.0	......	35.4	42.8	28.0	14.8	24.0	29.5	31.1	43.0	19.3	23.7	32.0	33.0	36.2	42.0	30.5	11.5
4	30.5	25.0	31.1	35.0	27.2	7.8	23.5	18.0	28.0	36.0	20.0	16.0	31.5	31.0	33.8	38.5	29.0	9.5
5	16.0	7.0	18.8	24.5	13.0	11.5	8.5	19.0	20.3	36.0	4.5	31.5	......	32.5	32.0	39.0	25.0	14.0
6	6.0	......	......	......	−2.5	......	11.5	9.5	10.7	15.5	6.0	9.5	25.5	28.0	28.5	33.5	23.5	10.0
7	24.5	30.5	27.2	35.0	19.5	15.5	12.0	9.5	6.0	21.0	−9.0	30.0	27.0	34.5	32.5	42.0	23.0	19.0
8	24.0	27.8	26.0	33.0	19.0	14.0	2.5	9.0	5.0	23.0	**−13.0**	**36.0**	31.5	33.5	37.7	47.5	28.0	19.5
9	26.0	26.0	25.0	31.0	19.0	12.0	17.5	18.0	11.9	22.0	1.8	20.2	22.5	22.0	......	......	5.0	......
10	10.0	−5.0	12.4	18.3	6.5	11.8	22.5	28.0	22.3	28.0	16.5	11.5	21.5	28.0	30.5	45.0	16.0	29.0
11	−14.5	−1.0	−13.5	2.0	**−29.0**	31.0	26.0	29.0	23.0	36.0	10.0	26.0	38.5	49.5	36.8	46.5	27.0	19.5
12	−8.0	−5.5	0.2	10.5	−10.2	20.7	31.5	30.5	30.5	43.0	18.0	25.0	35.0	38.0	41.5	**54.0**	29.0	25.0
13	−2.0	5.0	0.0	12.0	−12.0	24.0	29.8	31.0	28.5	39.0	18.0	21.0	36.0	35.5	41.0	53.0	29.0	24.0
14	14.0	21.0	13.0	22.0	4.0	18.0	9.5	24.0	18.0	26.0	10.0	16.0	34.5	18.0	33.0	37.0	29.0	8.0
15	22.5	23.0	22.9	30.8	15.0	15.8	21.0	30.0	29.5	36.0	23.0	13.0	13.0	19.5	18.0	28.0	8.0	20.0
16	24.0	22.5	24.9	30.8	19.0	11.8	21.5	32.0	30.0	41.0	19.0	22.0	......	3.0	16.5	28.0	5.0	23.0
17	16.0	−5.0	13.5	15.0	12.0	**3.0**	28.5	32.0	35.1	42.5	27.8	14.7	30.0	......	13.0	28.0	**−2.0**	**30.0**
18	−13.5	17.8	1.1	18.0	−15.7	33.7	26.5	31.0	33.5	40.0	27.0	13.0	25.0	32.5	30.0	44.0	16.0	28.0
19	23.7	29.0	......	32.3	......	......	27.0	36.0	34.3	42.5	26.0	16.5	32.0	33.0	38.0	47.0	29.0	18.0
20	19.3	8.5	......	25.7	......	......	33.0	35.5	38.0	46.0	30.0	16.0	23.0	29.0	30.7	37.5	24.0	13.5
21	22.7	19.5	......	25.3	......	......	30.5	35.0	39.5	**49.0**	30.0	19.0	20.0	18.0	21.0	27.0	15.0	12.0
22	7.5	19.0	15.2	26.0	4.3	21.7	30.0	34.0	34.5	41.5	27.5	14.0	22.0	23.5	18.0	32.0	4.0	28.0
23	12.0	14.7	21.4	35.0	7.8	27.2	22.0	14.0	23.2	24.5	22.0	**2.5**	23.0	32.5	28.5	39.0	18.0	21.0
24	10.3	36.5	26.6	48.0	5.2	**42.8**	13.0	16.0	18.3	33.0	3.5	29.5	25.0	30.0	31.5	43.0	20.0	23.0
25	......	23.0	26.7	45.0	8.5	36.5	3.5	21.0	15.0	33.0	−3.0	**36.0**	24.5	19.0	26.3	30.0	22.5	7.5
26	20.0	27.0	29.5	45.0	14.0	31.0	22.0	31.0	29.2	30.0	10.5	19.5	18.0	25.0	21.7	30.0	13.5	16.5
27	19.5	31.5	29.0	30.0	19.0	20.0	19.5	19.0	23.0	27.5	18.5	9.0	......	36.0	31.5	44.0	19.0	25.0
28	25.8	36.0	29.6	41.2	18.0	23.2	23.5	30.0	24.0	36.0	12.0	24.0	41.0	34.0	41.5	52.0	31.0	21.0
29	33.2	34.0	30.0	49.0	29.0	20.0	29.5	31.5	34.8	45.5	24.0	21.5	31.5	30.0	30.5	40.0	21.0	19.0
30	40.0	37.0	40.5	**52.0**	29.0	23.0							35.0	34.0	37.5	47.0	28.0	19.0
31	29.2	25.8	30.3	33.5	27.0	6.5							31.5	26.0	28.0	29.0	27.0	**2.0**
Sum .	511.4	578.1	557.4	914.0	281.6	546.6	613.8	730.8	720.6	1012.8	446.4	566.4	794.0	879.5	923.7	1199.5	653.0	551.5
Mean.	17.0	19.9	20.6	30.5	10.0	20.2	21.2	25.2	25.2	34.9	15.4	19.5	28.4	29.3	30.8	40.0	21.1	18.4

Table I.--Continued.

TEMPERATURE, 1892.

	APRIL.						MAY.						JUNE.					
Date.	7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.	7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.	7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.
1	24.0	27.0	27.0	35.0	19.0	16.0	49.0	52.5	49.9	63.0	36.8	26.2	47.0	57.0	49.5	67.5	31.5	36.0
2	......	30.5	32.0	41.0	23.0	18.0	41.0	38.0	40.2	49.5	31.0	18.5	57.0	62.0	59.2	73.0	45.5	27.5
3	22.5	26.0	28.2	40.5	16.0	24.5	29.5	45.0	39.3	52.5	26.0	26.5	62.0	51.1	56.8	71.1	42.5	28.6
4	21.5	20.5	22.0	24.0	20.0	4.0	40.0	35.5	40.7	45.5	36.0	9.5	32.0	31.0	34.5	38.0	31.0	**7.0**
5	18.5	30.5	27.0	39.0	15.0	24.0	34.5	38.0	36.3	45.0	27.5	17.5	32.5	46.0	39.8	49.5	30.0	19.5
6	38.0	41.0	39.8	52.0	27.5	24.5	36.5	39.5	41.2	56.5	26.0	30.5	41.0	57.0	47.7	66.0	**29.5**	36.5
7	38.5	35.5	39.5	48.0	31.0	17.0	34.5	34.5	37.8	44.0	31.5	12.5	52.0	62.5	56.0	74.0	38.0	36.0
8	21.5	35.5	31.5	45.0	18.0	27.0	36.0	42.5	36.0	43.0	29.0	14.0	55.0	63.0	58.5	74.0	43.0	31.0
9	40.0	41.0	40.5	50.0	31.0	19.0	31.0	37.0	37.7	48.0	27.5	20.5	60.0	66.0	58.5	75.0	42.0	33.0
10	35.0	35.0	40.0	49.0	31.0	18.0	37.0	39.5	38.3	51.5	**25.0**	26.5	58.0	50.0	54.7	67.0	42.3	24.7
11	36.5	33.5	40.0	53.0	27.0	26.0	41.5	46.0	44.2	54.0	34.5	19.5	43.2	51.0	48.0	56.9	39.1	17.8
12	33.5	24.0	33.0	37.0	29.0	8.0	32.3	37.0	38.0	47.0	29.0	18.0	40.1	43.8	47.4	57.8	37.1	20.7
13	20.0	28.0	27.0	39.5	14.5	25.0	32.5	32.0	47.3	64.0	30.5	33.5	39.9	53.3	44.4	59.0	29.8	29.2
14	24.0	40.0	36.0	51.0	21.0	30.0	29.5	41.5	36.5	46.5	26.5	20.0	53.2	64.8	59.9	71.9	47.8	24.1
15	42.5	47.0	46.1	59.3	33.0	26.3	41.5	49.5	43.0	60.5	25.5	35.0	55.2	43.8	55.0	69.6	40.4	29.2
16	36.0	46.5	44.0	60.0	28.0	**32.0**	44.0	45.5	46.1	54.0	38.3	15.7	48.9	44.9	48.6	55.2	42.0	13.2
17	42.0	40.0	41.8	56.5	27.0	29.5	42.5	50.0	47.5	59.0	36.0	23.0	50.1	58.2	51.7	65.6	37.9	27.7
18	32.5	27.0	36.2	43.5	29.0	14.5	40.5	55.0	44.5	60.0	29.0	31.0	57.9	61.5	57.7	73.9	41.5	32.4
19	25.0	20.5	24.5	26.0	23.0	**3.0**	45.5	37.0	48.3	57.5	39.0	18.5	60.7	67.4	61.1	74.1	48.0	26.1
20	22.0	19.0	21.0	23.0	19.0	4.0	32.0	36.5	35.0	45.0	**25.0**	20.0	63.4	67.7	57.7	73.0	42.4	30.6
21	19.0	26.0	21.5	32.0	**11.0**	21.0	32.5	51.0	43.7	57.5	30.0	27.5	63.7	71.5	65.8	79.5	52.2	27.3
22	30.0	35.0	34.3	46.5	22.0	24.5	47.0	60.5	51.4	**71.0**	31.8	**39.2**	67.0	61.0	65.8	**82.5**	49.0	33.5
23	40.5	36.0	37.0	50.0	24.0	26.0	56.5	45.0	53.9	69.3	38.5	30.8	58.2	53.5	63.9	75.0	52.9	22.1
24	37.0	45.0	37.5	52.0	23.0	29.0	51.5	52.5	54.3	61.5	47.0	14.5	52.6	60.5	60.5	73.5	47.5	26.0
25	37.0	45.5	43.2	53.5	33.0	20.5	50.0	56.0	53.0	67.5	38.5	29.0	50.0	72.5	63.0	**82.5**	43.5	**39.0**
26	42.0	36.0	46.5	56.5	36.5	20.0	52.5	60.0	53.2	70.0	36.5	33.5	55.5	62.0	63.0	77.5	48.5	29.0
27	29.0	30.0	31.5	41.0	22.0	19.0	54.0	52.5	52.5	63.5	41.5	22.0	57.2	67.0	60.9	78.0	43.7	34.3
28	32.0	44.0	36.5	51.0	22.0	29.0	52.0	54.5	52.8	63.0	42.5	20.5	61.0	70.0	61.2	80.5	42.0	38.5
29	50.0	36.0	51.3	**65.5**	37.0	28.5	50.5	52.0	52.2	61.0	43.5	17.5	61.5	60.5	59.9	70.8	49.0	31.8
30	47.0	53.0	50.0	63.5	36.5	27.0	52.5	34.5	40.3	44.5	36.0	**8.5**	58.5	62.5	61.0	77.5	44.5	33.0
31							36.5	49.0	42.7	52.5	33.0	19.5						
Sum	937.0	1034.5	1066.4	1383.8	749.0	634.8	1286.3	1399.5	1377.8	1727.3	1028.4	698.9	1612.3	1743.0	1671.7	2089.4	1254.1	835.3
Mean	32.3	34.5	35.5	46.1	25.0	21.2	41.5	45.1	44.4	55.7	33.2	22.5	52.1	58.1	55.7	60.6	41.8	27.8

Table I.--Continued.

TEMPERATURE, 1892.

Date.	JULY. 7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.
1	60.5	61.5	63.5	77.5	49.5	28.0
2	52.8	47.0	51.2	56.5	46.0	10.5
3	48.5	58.5	55.5	68.5	42.5	26.0
4	55.5	58.5	59.8	77.0	42.5	34.5
5	60.5	70.0	64.1	82.8	45.5	37.3
6	61.5	75.0	67.2	84.8	49.5	35.3
7	64.0	54.5	64.9	72.5	57.3	15.2
8	56.5	55.5	57.5	66.0	49.0	17.0
9	54.0	60.0	56.7	68.5	45.0	23.5
10	56.5	70.0	62.3	78.0	46.5	31.5
11	59.0	66.0	64.5	78.0	51.0	27.0
12	56.0	63.0	61.0	76.0	46.0	30.0
13	63.3	68.5	67.6	79.3	56.0	23.3
14	64.0	65.0	66.5	82.0	51.0	31.0
15	60.0	63.0	63.3	70.5	56.0	14.5
16	60.5	60.5	64.5	81.0	48.0	33.0
17	64.0	66.5	65.6	78.0	53.3	24.7
18	68.5	69.5	63.9	81.0	46.7	34.3
19	66.8	71.5	66.3	**85.1**	47.5	**37.6**
20	60.0	68.5	71.2	85.0	57.5	27.5
21	65.0	60.0	68.3	82.0	54.5	27.5
22	62.5	65.5	68.3	84.8	51.8	33.0
23	66.5	60.0	69.4	80.8	58.0	22.8
24	61.0	62.0	64.7	80.0	49.5	30.5
25	58.5	67.0	65.8	80.0	51.6	28.4
26	59.0	66.0	65.5	81.0	50.0	31.0
27	55.0	49.5	56.8	58.8	54.8	**4.0**
28	49.5	55.5	55.6	64.8	46.3	18.5
29	53.5	60.4	55.2	70.0	**40.5**	29.5
30	54.5	66.0	60.3	75.0	45.5	29.5
31	56.5	66.5	61.3	79.0	43.7	35.3
Sum.	1842.9	1959.9	1948.3	2364.2	1532.5	831.7
Mean.	59.4	63.2	62.8	76.3	49.4	26.8

Date.	AUGUST. 7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.
1	59.3	71.5	64.7	84.5	45.0	39.5
2	64.0	69.5	68.2	84.5	51.8	32.7
3	65.0	74.0	70.0	85.5	54.5	31.0
4	63.0	72.5	68.0	85.5	50.5	35.0
5	56.5	66.5	66.5	84.5	48.5	36.0
6	62.0	66.0	65.8	82.2	49.5	32.7
7	63.3	67.5	67.8	78.5	57.0	**21.5**
8	57.5	55.0	60.1	71.5	48.8	22.7
9	51.0	61.0	58.0	74.0	42.0	32.0
10	50.0	65.0	63.0	78.0	48.0	30.0
11	63.0	65.8	62.0	79.0	45.0	34.0
12	60.5	67.3	65.5	82.0	49.0	33.0
13	60.1	71.0	66.8	83.5	50.0	33.5
14	62.0	70.0	64.7	**86.0**	43.5	**42.5**
15	60.0	68.8	67.5	85.0	49.9	35.1
16	58.5	70.0	66.5	**86.0**	47.0	39.0
17	62.5	64.1	66.0	81.5	50.5	31.0
18	51.5	59.8	54.7	69.0	40.5	28.5
19	58.0	64.5	58.5	73.0	43.9	29.1
20	46.7	58.0	56.8	72.7	41.0	31.7
21	54.8	62.0	58.9	73.5	44.3	29.2
22	52.8	53.3	60.2	73.0	47.4	25.6
23	47.0	58.3	56.5	71.0	41.9	29.1
24	48.3	65.8	59.2	76.0	42.5	33.5
25	57.0	60.0	62.5	75.0	50.0	25.0
26	53.5	61.0	59.3	75.8	42.8	33.0
27	56.5	61.0	60.0	73.0	47.0	26.0
28	40.3	40.3	....	....	39.3	....
29	34.0	47.0	45.8	61.5	**30.0**	31.5
30	48.0	59.0	55.5	74.0	37.0	37.0
31	53.0	61.1	58.7	78.0	39.5	38.5
Sum.	1728.6	1956.6	1857.7	2337.2	1417.6	958.9
Mean.	55.8	63.1	61.9	77.9	45.7	32.0

Date.	SEPTEMBER. 7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.
1	46.8	68.5	58.2	79.5	37.0	42.5
2	57.0	54.0	58.5	69.2	47.8	21.4
3	50.5	54.5	54.6	68.3	40.9	27.4
4	45.3	53.0	51.9	68.3	35.4	32.9
5	46.3	56.5	56.2	76.5	36.0	40.5
6	56.4	66.0	58.9	77.8	39.0	38.8
7	53.3	53.5	56.2	74.8	37.5	37.3
8	50.8	49.0	55.9	66.0	45.9	**20.1**
9	43.0	53.7	56.3	73.7	38.8	34.9
10	42.0	40.5	....	....	36.9	....
11	35.0	48.0	43.0	63.0	**23.0**	40.0
12	40.7	54.0	48.3	68.2	28.5	39.7
13	43.8	57.8	52.6	73.2	32.0	41.2
14	41.8	62.3	52.9	74.8	30.9	**43.9**
15	55.8	62.9	58.3	76.9	39.8	37.1
16	54.0	62.7	60.4	74.7	46.0	28.7
17	56.5	57.8	60.5	76.0	45.0	31.0
18	54.5	65.0	58.3	75.2	41.5	33.7
19	46.0	60.3	55.5	73.0	38.0	35.0
20	49.0	49.5	53.9	69.8	38.0	31.8
21	47.7	55.8	53.0	70.0	36.0	34.0
22	46.4	53.5	53.1	71.2	35.0	36.2
23	51.7	57.8	56.8	70.6	43.0	27.6
24	54.1	60.5	61.2	72.8	49.5	23.3
25	54.0	54.0	59.9	74.8	45.0	29.8
26	41.0	58.5	57.1	78.2	36.0	42.2
27	47.0	56.8	57.0	74.0	40.0	34.0
28	47.5	55.5	59.8	79.1	40.5	38.6
29	44.8	60.0	58.6	78.0	39.2	38.8
30	41.8	66.0	58.8	**80.8**	36.9	**43.9**
31						
Sum.	1444.5	1707.9	1625.2	2128.4	1159.0	1006.3
Mean.	48.1	56.9	56.0	73.4	38.6	34.7

Table I.—Concluded.

TEMPERATURE, 1892.

Date.	October 7a.m.	October 7p.m.	October Mean.	October Max.	October Min.	October Daily Range.	November 7 a.m.	November 7 p.m	November Mean.	November Max.	November Min	November Daily Range.	December 7 a.m.	December 7 p.m	December Mean.	December Max.	December Min.	December Daily Range.
1	49.8	52.2	61.7	**78.5**	45.0	33.5	35.0	24.9	33.0	35.0	31.0	**4.0**	40.0	32.0	40.0	**50.9**	29.1	21.8
2	44.3	50.0	48.4	63.5	33.2	30.3	26.0	11.0	29.2	34.5	24.0	10.	31.8	32.3	32.7	41.7	23.6	18.1
3	34.0	50.3	49.0	71.0	27.0	**44.0**	23.7	24.8	25.1	41.9	**8.2**	**33.7**	33.7	34.2	38.0	49.0	27.0	22.0
4	34.0	47.0	48.2	69.0	27.5	41.5	32.4	34.2	34.7	49.1	20.3	28.8	35.8	32.0	37.4	48.2	26.7	21.5
5	34.7	44.9	47.2	68.8	25.5	43.3	36.3	39.5	42.7	54.5	31.0	23.5	25.2	15.0	29.3	32.8	25.8	7.0
6	34.7	52.0	48.7	68.2	29.3	38.9	25.6	21.7	28.3	31.2	25.4	5.8	19.8	17.0	19.4	23.9	15.0	8.9
7	34.3	49.1	45.4	61.0	29.8	31.2	14.7	24.2	22.6	31.2	14.0	17.2	10.4	6.9	12.9	19.9	6.0	13.9
8	35.0	45.5	51.8	71.5	32.0	39.5	25.0	21.3	26.4	29.7	23.0	6.7	12.5	12.2	14.0	22.0	6.0	16.0
9	48.5	51.3	52.2	65.5	39.0	26.5	17.2	28.8	25.1	35.6	14.7	20.9	1.3	19.8	14.0	27.9	0.0	27.9
10	45.0	42.1	49.9	57.3	42.5	14.8	33.0	41.0	37.6	49.2	26.0	23.2	13.5	16.5	20.4	28.9	11.9	17.0
11	42.2	32.0	44.3	58.0	30.5	27.5	36.6	40.0	43.5	53.1	33.9	19.2	11.1	8.5	18.0	26.5	9.5	17.0
12	.....	....	31.5	35.0	28.0	7.0	38.3	41.8	45.9	**56.0**	35.8	20.2	3.0	18.0	16.6	33.5	0.3	33.8
13	.....	.....	29.7	38.0	21.5	16.5	17.0	28.9	26.9	37.8	15.9	21.9	7.5	11.5	13.2	18.8	7.6	11.2
14	35.5	33.1	35.3	50.5	20.0	30.5	38.0	35.7	38.4	51.9	25.0	26.9	2.5	—3.5	8.3	16.4	0.2	16.2
15	25.5	30.1	37.1	57.3	17.0	40.3	16.8	19.8	23.2	30.4	15.9	14.5	9.5	13.5	10.8	24.0	-2.5	26.5
16	42.5	37.0	46.1	58.0	34.2	23.8	19.0	16.0	20.2	25.5	15.0	10.5	12.4	0.5	13.0	13.7	12.4	**1.3**
17	25.0	24.0	29.9	37.1	22.7	14.4	11.4	26.1	19.8	28.9	10.7	18.2	5.5	4.2	1.0	14.5	12.5	27.0
18	26.0	24.1	31.8	40.5	23.0	17.5	27.0	35.8	35.0	44.0	25.9	18.1	2.5	15.2	7.9	19.8	4.0	23.8
19	20.5	25.4	24.4	33.9	14.9	19.0	40.6	39.0	42.4	51.8	33.0	18.8	6.2	9.5	5.0	18.0	-8.0	26.0
20	15.0	33.0	27.2	43.0	**11.5**	31.5	34.0	27.9	39.8	45.7	34.0	11.7	8.2	10.5	5.4	10.0	0.8	9.2
21	19.3	27.0	27.5	40.5	14.5	26.0	34.0	38.6	35.6	47.6	23.5	24.1	3.5	11.8	1.2	18.5	**-16.2**	**34.7**
22	28.6	29.2	......	44.0	.....	......	31.7	35.0	41.4	50.8	32.0	18.8	20.5	27.7	16.2	32.5	0.0	32.5
23	22.0	34.0	32.8	45.0	20.5	24.5	32.9	40.0	40.7	52.7	28.8	23.9	23.8	32.5	38.1	46.2	30.0	16.2
24	21.5	27.0	31.3	44.8	17.8	27.0	44.7	30.8	40.6	**56.0**	25.2	30.8	37.5	39.8	39.4	48.8	30.0	18.8
25	23.6	27.3	28.7	42.0	15.5	26.5	14.0	21.0	21.4	27.9	14.9	13.0	33.3	26.8	34.2	36.5	31.8	4.7
26	21.8	31.0	31.6	45.0	18.2	26.8	25.9	25.0	21.3	24.9	17.6	7.3	26.0	33.8	26.7	38.0	15.5	22.5
27	32.5	37.1	40.5	54.8	26.2	28.6	24.0	36.0	20.3	39.8	18.8	21.0	23.0	20.7	30.5	35.0	26.0	9.0
28	32.2	41.0	40.3	51.5	29.1	22.4	32.8	41.8	38.3	47.0	29.6	17.4	15.8	31.0	23.4	37.2	9.5	27.7
29	37.8	34.0	42.7	54.0	31.3	22.7	38.0	37.0	43.0	50.1	36.0	14.1	24.8	17.8	29.0	33.5	24.5	9.0
30	33.0	31.8	30.1	33.5	26.8	**6.7**	37.0	39.0	42.6	52.0	33.1	18.9	10.7	23.2	20.6	31.0	10.2	20.8
31	25.5	35.0	32.1	45.2	19.0	26.2							24.2	19.8	23.7	30.5	17.0	13.5
Sum .	924.3	1086.5	1177.5	1625.9	773.0	808.9	862.6	928.6	994.0	1265.8	722.2	543.6	521.5	569.7	640.3	928.1	352.6	575.5
Mean.	31.9	37.5	30.2	52.5	25.7	27.0	28.7	30.9	33.1	42.2	24.1	18.1	16.8	18.4	20.7	30.0	11.4	18.6

Table II. **TERRESTRIAL RADIATION.**

Date.	JANUARY Min.	JANUARY Ter. Ther.	JANUARY Rad.	FEBRUARY Min.	FEBRUARY Ter. Ther.	FEBRUARY Rad.	MARCH Min.	MARCH Ter. Ther.	MARCH Rad.	APRIL Min.	APRIL Ter. Ther.	APRIL Rad.	MAY Min.	MAY Ter. Ther.	MAY Rad.	JUNE Min.	JUNE Ter. Ther.	JUNE Rad.
1	-4.0	-4.0	0.0	16.5	19.0		30.0	28.0	2.0	19.0	19.5		36.8	31.0	5.8	31.5	30.0	1.5
2	11.0	10.7	0.3	21.0	17.0	4.0	30.0	26.5	3.5	23.0	20.5	2.5	31.0	28.5	2.5	45.5	42.8	2.7
3	28.0	27.9	0.1	19.3	18.8	0.5	30.5	27.0	3.5	16.0	13.0	3.0	26.0	25.0	1.0	42.5	35.0	7.5
4	27.2	26.0	1.2	20.0	22.0		29.0	26.5	2.5	20.0	18.5	1.5	36.0	36.0	0.0	31.0	31.0	0.0
5	13.0	15.0		4.5	0.0	4.5	25.0	23.5	1.5	15.0	8.5	6.5	27.5	27.0	0.5	30.0	30.0	0.0
6	-2.5	-5.0	2.5	6.0	-1.0	7.0	23.5	24.0		27.5	26.0	1.5	26.0	23.0	3.0	29.5	27.5	2.0
7	19.5	19.8		-9.0	-11.0	2.0	23.0	21.0	2.0	31.0	30.0	1.0	31.5	30.5	1.0	38.0	34.0	4.0
8	19.0	19.0	0.0	-13.0	-17.0	4.0	28.0	24.0	4.0	18.0	19.5		29.0	29.3		43.0	35.0	8.0
9	19.0	17.8	1.2	1.8	2.0		5.0	2.0	3.0	31.0	26.0	5.0	27.5	28.0		42.0	37.0	5.0
10	6.5	......	...	16.5	16.0	0.5	16.0	12.0	4.0	31.0	31.0	0.0	25.0	21.5	3.5	42.3	37.5	4.8
11	-29.0	-30.0	1.0	10.0	8.0	2.0	27.0	23.0	4.0	27.0	24.0	3.0	34.5	33.0	1.5	39.0	35.3	3.7
12	-10.2	11.0	0.8	18.0	22.0		29.0	25.0	4.0	29.0	27.0	2.0	29.0	27.8	1.2	37.1	35.2	1.9
13	-12.0	......	......	18.0	23.0		29.0	27.0	2.0	14.5	11.0	3.5	30.5	28.5	2.0	29.8	25.4	4.4
14	4.0	3.4	0.6	10.0	16.0		29.0	26.0	3.0	21.0	16.5	4.5	26.5	27.0		47.8	45.6	2.2
15	15.0	15.0	0.0	23.0	......	......	8.0	5.0	3.0	33.0	....		25.5	30.0		40.4	37.8	2.6
16	19.0	15.0	4.0	19.0	......	......	5.0	5.0	0.0	28.0	24.0	4.0	38.3	36.5	1.8	42.0	39.7	2.3
17	12.0	11.0	1.0	27.8	......	......	-2.0	7.0	5.0	27.0	21.5	5.5	36.0	35.0	1.0	37.9	36.1	1.8
18	-15.7	-17.0	2.7	27.0	......	....	16.0	14.0	2.0	29.0	27.0	2.0	29.0	26.5	2.5	41.5	43.8	
19	......	-12.5	......	26.0	22.5	3.5	29.0	24.0	5.0	23.0	22.3	0.7	39.0	33.5	5.5	48.0	43.8	4.2
20	......	14.0	...	30.0	27.0	3.0	24.0	23.0	1.0	19.0	18.5	0.5	25.0	23.0	2.0	42.4	42.4	0.0
21	......	3.5	......	30.0	27.0	3.0	15.0	11.0	4.0	11.0	7.5	3.5	30.0	29.0	1.0	52.2	47.5	4.7
22	4.3	-1.2	5.5	27.5	23.0	4.5	4.0	-1.0	5.0	22.0	19.3	2.7	31.8	28.0	3.8	49.0	45.0	4.0
23	7.8	5.8	2.0	22.0	21.0	1.0	18.0	15.5	2.5	24.0	20.5	3.5	38.5	33.5	5.0	52.9	49.2	3.7
24	5.2	2.0	3.2	3.5	0.5	3.0	20.0	15.0	5.0	23.0	26.0		47.0	45.5	1.5	47.5	46.5	1.0
25	8.5	6.0	2.5	3.0	4.0	1.0	22.5	21.0	1.5	33.0	32.5	0.5	38.5	37.0	1.5	43.5	40.1	3.4
26	14.0	10.2	3.8	19.5	18.5	1.0	13.5	11.5	2.0	36.5	......		36.5	33.8	2.7	48.5	45.5	3.0
27	19.0	16.0	3.0	18.5	16.5	2.0	19.0	15.5	3.5	22.0	20.0	2.0	41.5	39.0	2.5	43.7	41.0	2.7
28	18.0	16.3	1.7	12.0	10.0	2.0	31.0	24.5	6.5	22.0	19.0	3.0	42.5	40.5	2.0	42.0	38.0	4.0
29	29.0	27.0	2.0	24.0	22.0	2.0	21.0	19.0	2.0	37.0	33.0	4.0	43.5	38.0	5.5	49.0	45.0	4.0
30	29.0	28.0	1.0				28.0	20.5	7.5	36.5	31.8	4.7	36.0	33.5	2.5	44.5	40.8	3.7
31	27.0	29.0					27.0	24.5	2.5				33.0	32.5	0.5			
Sum	281.6	257.7	40.1	446.4	318.8	50.5	653.0	556.5	97.0	749.0	613.9	70.6	1028.4	970.9	63.3	1254.1	1163.5	92.8
Mean.	10.0	8.2	1.7	15.4	12.7	2.7	21.1	17.9	3.2	25.0	21.9	2.8	33.2	31.3	2.3	41.8	38.8	3.1

Table II.--Concluded. **TERRESTRIAL RADIATION.**

Date.	JULY Min.	JULY Ter. Ther.	JULY Rad.	AUGUST Min.	AUGUST Ter. Ther.	AUGUST Rad.	SEPTEMBER Min.	SEPTEMBER Ter. Ther.	SEPTEMBER Rad.	OCTOBER Min.	OCTOBER Ter. Ther.	OCTOBER Rad.	NOVEMBER Min.	NOVEMBER Ter. Ther.	NOVEMBER Rad.	DECEMBER Min.	DECEMBER Ter. Ther.	DECEMBER Rad.
1	49.5	47.5	2.0	45.0	40.0	5.0	37.0	35.0	2.0	45.0	41.0	4.0	31.0	29.0	2.0	29.1	24.9	4.2
2	46.0	41.8	4.2	51.8	46.5	5.3	47.8	43.5	4.3	33.2	29.0	4.2	24.0	18.0	6.0	23.6	20.2	3.4
3	42.5	40.0	2.5	54.5	50.0	4.5	40.9	37.3	3.6	27.0	22.7	4.3	8.2	3.9	4.3	27.0	24.1	2.9
4	42.5	39.0	3.5	50.5	46.0	4.5	35.4	31.7	3.7	27.5	21.8	5.7	20.3	18.0	2.3	26.7	21.8	4.9
5	45.5	40.5	5.0	48.5	46.0	2.5	36.0	31.6	4.4	25.5	20.0	5.5	31.0	28.8	2.2	25.8	23.9	1.9
6	49.5	43.5	6.0	49.5	47.0	2.5	39.0	34.3	4.7	29.3	25.8	3.5	25.4	23.2	2.2	15.0	12.2	2.8
7	57.3	54.7	2.6	57.0	54.3	2.7	37.5	33.0	4.5	29.8	25.9	3.9	14.0	10.0	4.0	6.0	3.9	2.1
8	49.0	47.5	1.5	48.8	46.5	2.3	45.9	45.5	0.4	32.0	26.5	5.5	23.0	20.9	2.1	6.0	3.2	2.8
9	45.0	43.5	1.5	42.0	38.8	3.2	38.8	35.1	3.7	39.0	33.8	5.2	14.7	9.4	5.3	0.0	−3.2	3.2
10	46.5	43.0	3.5	48.0	45.2	2.8	36.9	36.2	0.7	42.5	40.3	2.2	26.0	22.7	3.3	11.9	8.5	3.4
11	51.0	43.0	8.0	45.0	39.0	6.0	23.0	17.8	5.2	30.5	25.1	5.4	33.9	27.0	6.9	9.5	4.0	5.5
12	46.0	43.0	3.0	49.0	43.5	5.5	28.5	22.9	5.6	28.0	......	.....	35.8	30.2	5.6	0.3	−3.5	3.2
13	56.0	53.0	3.0	50.0	45.0	5.0	32.0	27.7	4.3	21.5	......	.....	15.9	13.0	2.9	7.6	4.0	3.6
14	51.0	47.0	4.0	43.5	39.8	3.7	30.9	26.3	4.6	20.0	......	.....	25.0	19.2	5.8	0.2	−0.3	0.1
15	56.0	54.5	1.5	49.9	44.0	5.9	39.8	32.6	7.2	17.0	16.0	1.0	15.9	14.0	1.9	2.5	5.4	2.9
16	48.0	42.8	5.2	47.0	43.0	4.0	46.0	42.2	3.8	34.2	31.0	3.2	15.0	11.0	4.0	12.4	12.4	0.0
17	53.3	51.0	2.3	50.5	46.7	3.8	45.0	38.0	7.0	22.7	22.3	0.4	10.7	8.8	1.9	−12.5	−14.0	1.5
18	46.7	44.0	2.7	40.5	35.0	5.5	41.5	36.8	4.7	23.0	19.0	4.0	25.9	23.0	2.9	4.0	7.0	3.0
19	47.5	43.5	4.0	43.9	39.5	4.4	38.0	31.4	6.6	14.9	15.1		33.0	30.0	3.0	−8.0	−11.5	3.5
20	57.5	54.0	3.5	41.0	36.5	4.5	38.0	29.6	8.4	11.5	8.2	3.3	34.0	31.9	2.1	0.8	3.5	4.3
21	54.5	51.0	3.5	44.3	39.2	5.1	36.0	31.7	4.3	14.5	10.9	3.6	23.5	19.9	3.6	16.2	23.0	6.8
22	51.8	48.8	3.0	47.4	44.5	2.9	35.0	25.8	8.2	......	14.3	......	32.0	31.8	0.2	0.0	−9.1	9.1
23	58.0	54.0	4.0	41.9	40.0	1.9	43.0	36.5	6.5	20.5	15.0	5.5	28.8	25.3	3.5	30.0	24.2	5.8
24	49.5	45.8	3.7	42.5	40.8	1.7	49.5	42.0	7.5	17.8	15.0	2.8	25.2	20.3	4.9	30.0	26.5	3.5
25	51.6	48.0	3.6	50.0	47.0	3.0	45.0	37.0	8.0	15.5	12.0	3.5	14.9	13.0	1.9	31.8	31.5	0.3
26	50.0	47.5	2.5	42.8	39.1	3.7	36.0	30.6	5.4	18.2	10.2	8.0	17.6	15.0	2.6	15.5	12.5	3.0
27	54.8	53.5	1.3	47.0	43.0	4.0	40.0	34.9	5.1	26.2	22.5	3.7	18.8	14.9	3.9	26.0	21.5	4.5
28	46.3	45.0	1.3	39.3	39.8	....	40.5	36.0	4.5	29.1	23.6	5.5	29.6	26.0	3.6	9.5	6.5	3.0
29	40.5	38.0	2.5	30.0	29.1	0.9	39.2	33.1	6.1	31.3	27.0	4.3	36.0	33.0	3.0	24.5	23.5	1.0
30	45.5	40.8	4.7	37.0	32.0	5.0	36.9	32.8	4.1	25.8	23.0	3.8	33.1	30.0	3.1	10.2	6.2	4.0
31	43.7	38.5	5.2	39.5	32.0	7.5				19.0	17.0	2.0				17.0	13.8	3.2
Sum	1532.5	1427.7	104.8	1417.6	1298.8	119.3	1159.0	1009.9	149.1	773.0	614.0	104.0	722.2	621.2	101.0	352.6	218.8	103.4
Mean.	49.4	46.0	3.4	45.7	41.9	4.0	38.6	33.7	4.9	25.7	21.9	4.0	24.1	20.7	3.4	11.4	8.0	3.4

Table III. **Per Cent of Saturation of the Air and Temperature of the Dew Point.**

Date.	JANUARY.						FEBRUARY.						MARCH.					
	RELATIVE HUMIDITY			DEW POINT			RELATIVE HUMIDITY			DEW POINT			RELATIVE HUMIDITY			DEW POINT		
	7 a. m.	7 p. m.	Mean.	7 a.m.	7 p.m.	Mean.	7 a.m.	7 p.m.	Mean.	7 a.m.	7 p.m.	Mean.	7 a.m.	7 p.m.	Mean.	7 a.m.	7 p.m.	Mean.
1	70.2	74.8	72.5	4.3	8.3	6.3	94.6	90.4	92.5	18.3	22.4	20.3	83.4	70.1	76.7	26.8	26.6	26.7
2	73.7	66.3	70.0	16.7	22.8	19.7	74.0	89.2	81.6	17.0	20.3	18.7	67.0	79.2	73.1	22.6	29.0	25.8
3	62.4	......	......	10.8	......	......	78.0	73.0	75.5	18.0	22.0	20.0	73.0	95.2	84.1	24.3	31.1	27.7
4	82.7	70.0	76.3	25.1	16.0	20.6	90.0	93.1	91.5	21.0	16.7	18.8	86.3	74.7	80.5	27.7	23.3	25.5
5	86.1	56.0	71.1	12.7	2.0	7.3	90.7	86.5	88.6	6.3	15.5	10.9	......	84.0	......	......	28.3	......
6	79.0	......	...	1.0	......	......	83.9	85.5	84.7	7.3	5.5	6.4	93.1	83.0	88.1	23.7	23.0	23.3
7	62.6	69.3	65.9	16.2	21.4	18.8	76.0	91.2	83.6	5.5	7.3	6.4	85.4	94.5	89.9	22.8	31.9	27.4
8	89.8	82.6	86.2	21.4	23.2	22.3	89.5	81.8	85.7	0.0	4.7	2.4	70.5	88.0	79.3	22.4	30.1	26.2
9	83.8	85.6	84.7	21.6	21.6	21.6	74.6	87.1	80.8	10.7	14.7	12.7	90.0	77.5	83.8	20.0	16.5	18.2
10	90.8	71.0	80.9	7.7	−12.0	−2.2	82.1	86.6	84.3	18.2	24.2	21.2	92.3	83.0	87.6	19.8	23.0	21.4
11	74.0	74.5	74.3	−21.0	−8.5	−14.7	84.4	83.6	84.0	21.8	23.8	22.8	43.1	84.2	63.7	17.8	33.3	25.5
12	83.0	83.5	83.2	−11.0	−9.0	−10.0	67.5	93.7	80.6	21.6	28.5	25.0	56.5	49.4	52.9	21.0	20.7	20.9
13	83.5	79.0	81.3	−5.5	1.0	−2.3	63.5	67.0	65.3	19.2	21.2	20.2	59.0	59.5	59.3	22.8	23.0	22.9
14	78.1	94.4	86.2	8.7	19.4	14.0	84.6	69.0	76.8	15.2	15.0	15.1	94.7	74.5	84.6	32.7	11.5	22.1
15	70.0	62.0	66.0	14.0	12.3	13.2	77.2	56.0	66.6	15.5	16.2	15.9	93.0	83.4	88.2	11.0	15.3	13.1
16	78.0	97.6	87.8	18.0	21.0	19.5	66.4	68.0	67.2	11.8	22.2	17.0	......	88.5	......	......	0.5	......
17	94.9	82.0	88.5	14.3	−9.0	2.6	65.7	68.0	66.8	18.5	22.2	20.3	100.	......	......	30.0	......	......
18	82.5	70.6	76.5	−16.0	9.7	−3.2	70.0	74.7	72.4	18.0	23.3	20.7	97.6	88.0	92.8	24.2	29.1	26.7
19	75.1	79.2	77.2	16.5	23.2	19.8	69.6	62.4	66.0	18.2	24.2	21.2	91.5	91.0	91.2	29.3	30.2	29.7
20	96.7	98.0	97.3	18.5	7.0	12.8	83.5	68.4	75.9	28.7	26.3	27.5	90.0	95.5	92.8	20.5	27.2	23.9
21	48.4	84.6	66.5	6.7	15.7	11.2	69.0	69.6	69.3	21.4	25.8	23.6	100.	93.4	96.7	20.0	16.8	18.4
22	97.4	85.0	91.2	6.7	9.0	7.8	74.2	79.0	76.6	22.4	28.2	25.3	94.0	92.8	93.4	20.3	21.8	21.0
23	91.8	89.7	90.8	9.7	12.3	11.0	88.8	85.1	87.0	19.4	10.7	15.0	90.0	88.0	89.0	20.5	29.1	24.8
24	79.1	95.9	87.5	5.0	35.6	20.3	88.1	86.1	87.1	9.7	12.7	11.2	90.4	90.6	90.5	22.4	27.3	24.9
25	......	77.6	......	......	17.2	......	89.0	93.7	91.3	1.0	19.2	10.1	91.0	97.9	94.4	22.0	18.3	20.1
26	74.5	70.6	72.5	21.6	27.7	24.7	88.8	88.5	88.7	19.4	26.7	23.1	74.5	89.2	81.9	11.5	22.2	16.9
27	94.6	90.0	92.3	18.2	28.5	23.3	87.0	93.4	90.2	16.0	17.8	16.9	......	84.8	......	......	31.7	......
28	90.7	53.4	72.1	23.5	21.2	22.4	77.8	74.2	76.0	17.6	22.4	20.0	79.6	88.0	83.8	34.9	30.6	32.7
29	66.1	69.0	67.5	23.3	24.8	24.0	73.0	78.5	75.7	22.0	25.3	23.6	82.6	84.0	83.3	17.4	27.0	22.2
30	86.4	78.0	82.2	35.6	30.0	32.8							84.5	95.2	89.8	30.7	32.1	31.4
31	87.9	81.0	84.5	25.8	20.5	23.2							91.5	100.	95.8	28.8	26.0	27.4
Sums.	2413.8	2271.2	2233.0	350.1	412.9	366.8	2301.5	2323.3	2312.3	459.7	565.0	512.3	2344.5	2547.2	2267.2	647.9	736.3	646.8
Means	80.5	79.4	79.8	11.7	14.2	13.1	79.3	80.1	79.7	15.8	19.4	17.6	83.7	84.9	83.9	23.1	24.5	23.9

Table III. **Per Cent of Saturation of the Air and Temperature of the Dew Point.**

Date.	April. Relative Humidity 7 a.m.	7 p.m.	Mean	April. Dew Point 7 a.m.	7 p.m.	Mean	May. Relative Humidity 7 a.m.	7 p.m.	Mean.	May. Dew Point 7 a.m.	7 p.m.	Mean.	June. Relative Humidity 7 a.m.	7 p.m.	Mean.	June. Dew Point 7 a.m.	7 p.m.	Mean.
1	89.8	94.6	92.2	21.4	25.2	23.3	29.7	21.0	25.3	18.7	13.5	16.1	52.0	35.4	43.7	30.0	29.6	29.8
2	......	91.6	....	....	27.8	....	75.8	88.2	82.0	33.9	34.5	34.2	57.8	29.0	43.4	42.5	29.0	35.7
3	93.3	94.6	93.9	20.7	24.2	22.4	93.7	63.6	78.7	27.7	32.8	30.2	27.7	73.5	50.6	27.7	42.9	35.3
4	93.7	82.5	88.1	19.8	16.0	17.9	77.8	52.5	65.1	33.9	20.0	27.0	100.	100.	100.	32.0	31.0	31.5
5	94.6	91.6	93.1	17.2	27.8	22.5	60.0	58.0	59.0	22.2	24.4	23.3	95.1	61.5	78.3	30.7	33.2	32.0
6	79.0	67.2	73.1	32.0	30.6	31.3	70.4	71.5	70.9	27.2	21.0	24.1	79.6	51.8	65.7	34.9	39.6	37.2
7	79.4	88.5	84.0	32.6	32.0	32.3	71.8	78.8	75.3	26.2	28.5	27.3	46.6	36.8	41.7	31.6	35.6	33.6
8	93.7	48.5	71.1	19.8	18.0	18.9	77.3	71.0	74.2	29.1	24.6	26.9	54.9	25.5	40.2	39.3	25.5	32.9
9	65.5	65.8	65.6	20.0	20.9	20.5	74.8	70.5	72.7	23.3	27.6	25.4	23.2	28.7	25.9	22.2	31.7	27.0
10	95.2	71.0	83.1	33.1	26.5	29.8	78.0	82.5	80.2	30.0	34.2	32.1	33.7	22.1	27.9	29.7	12.7	21.2
11	58.5	60.7	59.6	23.2	30.6	26.9	79.3	64.2	71.8	35.4	34.6	35.0	48.5	26.6	37.6	25.3	17.6	21.4
12	88.0	94.6	91.3	30.1	22.2	26.1	94.0	85.5	89.7	30.6	32.7	31.7	40.6	32.5	36.5	26.2	16.2	21.2
13	93.7	90.8	92.3	18.2	25.3	21.8	94.2	100.	97.1	30.7	32.0	31.3	77.9	51.1	64.5	33.4	35.8	34.6
14	69.0	83.2	76.1	15.0	34.8	24.9	100.	59.9	80.0	29.5	28.7	29.1	64.4	40.6	52.5	41.6	40.4	41.0
15	56.8	47.2	52.0	27.7	27.8	27.7	58.0	40.2	49.1	27.7	26.5	27.1	59.5	94.8	77.6	41.2	42.5	41.9
16	84.8	43.7	64.2	31.7	25.3	28.5	61.0	68.5	64.7	31.0	35.5	33.3	74.8	91.8	83.3	41.5	42.8	42.1
17	54.0	72.8	63.4	26.0	31.4	28.7	60.1	26.6	43.4	29.3	17.4	23.3	64.0	57.7	60.9	38.1	43.5	40.8
18	95.1	83.0	89.1	30.7	22.0	26.4	55.0	16.7	35.8	25.5	10.0	17.8	51.8	41.2	46.5	40.3	37.8	39.1
19	85.0	87.4	86.2	21.0	17.4	19.2	34.2	63.4	48.8	18.8	25.2	22.0	46.1	33.9	40.0	39.9	38.0	38.9
20	88.8	86.5	87.6	19.4	15.5	17.4	58.0	40.5	49.3	18.8	14.6	16.7	42.1	34.5	38.3	39.5	39.1	39.3
21	86.5	82.6	84.6	15.5	21.2	18.4	73.7	30.9	52.3	25.3	22.6	23.9	36.4	33.5	34.9	36.8	41.0	38.9
22	50.5	60.6	64.5	17.6	25.8	21.7	42.4	23.7	33.0	24.8	23.2	24.0	28.7	82.5	55.6	31.7	55.5	43.6
23	82.7	77.2	80.0	35.2	29.1	32.1	31.1	39.1	35.1	25.8	21.4	23.6	74.1	91.9	83.0	49.9	40.8	50.4
24	48.0	42.0	45.0	19.0	23.0	21.0	58.6	45.3	52.0	37.2	31.3	34.3	77.7	72.8	75.3	45.5	51.4	48.4
25	88.0	75.1	81.5	33.5	37.7	35.6	58.5	33.8	46.1	35.3	27.8	31.5	65.8	15.4	40.6	47.4	22.4	34.9
26	77.4	46.2	61.8	35.1	17.4	26.3	34.0	16.7	25.4	25.0	14.6	19.8	80.4	56.7	68.5	49.8	46.8	48.3
27	41.0	59.5	50.3	8.0	17.6	12.8	52.4	51.4	51.9	36.8	34.9	35.9	47.0	22.3	34.7	36.8	27.3	32.1
28	73.0	31.7	52.3	24.2	15.8	20.0	45.7	43.5	44.6	30.9	32.7	31.8	17.9	40.7	29.3	17.8	33.9	25.8
29	22.1	64.0	43.1	12.7	43.5	28.1	39.0	39.4	39.2	26.7	27.8	27.2	41.2	66.4	53.8	37.8	48.8	43.3
30	35.5	15.3	25.4	21.0	7.3	14.1	66.3	86.0	76.1	31.7	30.6	31.2	72.2	59.5	65.8	49.5	48.6	40.1
31							72.2	37.8	55.0	28.0	24.2	26.1						
Sums.	2171.6	2100.0	2094.5	690.4	748.7	705.6	1977.0	1670.7	1823.8	877.0	809.4	843.2	1681.4	1510.7	1596.0	1090.6	1092.0	1091.3
Means	74.9	70.3	72.2	23.8	24.9	24.3	63.8	53.8	58.8	28.3	26.1	27.2	56.5	50.4	53.2	36.4	36.4	36.4

Table III. **Per Cent of Saturation of the Air and Temperature of the Dew Point.**

Date.	JULY. Relative Humidity 7 a.m.	Relative Humidity 7 p.m.	Relative Humidity Mean.	Dew Point. 7 a.m.	Dew Point. 7 p.m.	Dew Point. Mean.	AUGUST. Relative Humidity 7 a.m.	Relative Humidity 7 p.m.	Relative Humidity Mean.	Dew Point 7 a.m.	Dew Point 7 p.m.	Dew Point Mean.	SEPTEMBER. Relative Humidity 7 a.m.	Relative Humidity 7 p.m.	Relative Humidity Mean.	Dew Point 7 a.m.	Dew Point 7 p.m.	Dew Point Mean.
1	67.6	17.2	42.4	49.3	16.8	33.0	43.0	25.5	34.2	36.5	34.0	35.2	58.5	17.1	37.8	32.6	22.6	27.6
2	44.4	90.6	67.5	31.0	44.4	37.7	31.0	23.2	27.1	33.0	30.1	31.6	55.9	63.1	59.5	41.3	41.7	41.5
3	76.0	60.0	68.0	41.5	44.8	43.2	42.4	21.9	32.2	41.2	32.6	36.9	62.7	66.0	64.3	37.9	43.0	40.5
4	66.3	57.7	62.0	43.9	43.9	43.9	54.9	30.0	42.4	46.9	39.0	42.9	74.3	67.6	71.0	37.1	42.4	39.7
5	26.6	29.9	28.2	25.4	36.9	31.1	69.6	39.1	54.4	46.8	40.8	43.8	73.6	17.3	45.4	38.0	12.3	25.2
6	52.5	28.2	40.4	43.8	39.9	41.9	51.8	37.2	44.5	43.9	39.2	41.6	21.5	16.5	19.0	17.8	19.2	18.5
7	55.1	89.2	72.1	47.7	51.4	49.5	49.9	38.0	43.9	43.9	41.0	42.4	28.1	48.3	38.2	20.5	33.9	27.2
8	78.2	81.5	79.9	49.9	50.2	50.1	73.6	73.5	73.6	49.2	47.5	48.4	67.2	36.0	51.6	40.0	23.0	31.5
9	73.6	59.8	66.7	45.2	45.9	45.5	82.8	45.9	64.3	45.6	40.3	42.9	36.4	15.9	26.2	18.2	8.3	13.2
10	67.6	39.5	53.5	45.9	44.5	45.2	51.5	34.1	42.8	39.5	36.1	37.8	61.2	42.6	51.9	29.1	19.2	24.2
11	70.2	49.6	59.9	49.1	46.3	47.7	44.4	35.8	40.1	41.2	37.8	39.5	54.5	27.5	41.0	20.2	15.5	17.8
12	64.0	54.2	59.1	43.5	46.2	44.9	42.6	26.7	34.7	37.7	31.6	34.7	40.7	38.1	39.4	18.2	29.1	23.7
13	45.9	48.9	47.4	42.1	48.6	45.3	28.4	15.9	22.1	26.5	21.8	24.1	46.4	26.0	36.0	24.2	22.8	23.5
14	47.0	62.2	54.6	43.0	51.6	47.3	31.7	19.8	25.8	31.7	26.0	28.9	46.5	17.3	31.9	22.6	17.4	20.0
15	74.8	77.8	76.3	51.9	55.4	53.7	31.7	23.0	27.3	29.7	29.6	29.6	30.7	17.3	24.0	25.3	18.2	21.7
16	59.0	62.2	60.6	46.0	47.1	46.5	39.2	23.3	31.3	33.6	30.3	32.0	37.5	26.3	31.9	28.5	27.0	27.8
17	56.0	41.0	48.5	48.0	42.5	45.3	47.8	48.4	48.1	42.5	44.5	43.5	31.5	31.5	31.5	26.2	27.5	26.8
18	28.1	33.1	30.6	33.8	35.4	34.6	38.0	41.4	39.7	27.0	36.0	31.5	49.8	14.3	32.0	36.1	15.5	25.8
19	35.2	24.9	30.1	38.8	33.4	36.1	57.5	36.3	46.9	43.0	37.4	40.2	51.3	33.0	42.2	29.1	31.3	30.2
20	39.5	43.9	41.7	43.5	45.7	44.6	64.6	57.5	61.0	35.0	43.0	39.0	46.2	50.9	48.5	28.8	31.6	30.2
21	55.8	39.5	47.6	48.9	43.5	46.2	74.2	66.9	70.6	47.0	51.3	49.1	43.7	27.6	35.7	26.4	22.6	24.5
22	57.6	48.9	53.3	47.8	45.7	46.7	79.2	70.3	74.7	46.2	43.5	44.9	44.5	23.3	33.9	25.8	16.8	21.3
23	49.6	66.2	57.9	45.7	48.4	47.1	100.	51.9	76.0	47.0	40.8	43.9	20.0	17.0	18.5	11.8	13.2	12.5
24	60.4	64.8	62.6	46.8	50.4	48.6	94.5	29.6	62.0	46.8	33.0	39.9	36.3	28.2	32.2	27.8	26.7	27.3
25	55.3	45.4	50.3	42.6	45.2	43.9	54.2	45.8	50.0	40.6	38.9	39.7	38.7	38.7	38.7	29.7	29.7	29.7
26	65.8	37.2	51.5	47.4	39.2	43.3	54.5	23.5	39.0	37.2	23.5	30.4	65.8	20.0	42.9	29.9	18.0	23.8
27	54.9	88.1	71.5	39.3	45.9	42.6	43.0	22.4	32.7	34.2	22.4	28.3	69.6	27.7	48.7	37.4	25.3	31.4
28	83.6	64.2	73.9	44.7	43.1	43.9	98.8	82.8	90.8	40.0	35.0	37.5	58.5	60.7	59.6	33.4	41.9	37.6
29	73.1	42.9	58.0	44.7	37.8	41.2	20.2	52.0	36.1	-4.5	30.0	12.7	54.6	29.2	41.9	28.7	27.2	27.9
30	63.6	37.2	50.4	42.2	39.2	40.7	46.5	24.0	35.3	28.7	22.0	25.4	56.3	21.2	38.7	26.5	25.2	25.8
31	67.6	31.5	49.6	46.2	35.0	40.6	34.2	28.2	31.2	25.8	27.3	26.5						
Sums.	1814.9	1617.3	1716.1	1359.6	1344.3	1351.9	1675.7	1193.9	1434.8	1167.9	1086.3	1124.8	1462.5	966.2	1214.3	849.1	748.1	798.4
Means	58.5	52.2	55.3	43.9	43.4	43.6	54.1	38.5	46.3	37.9	35.0	36.3	48.8	32.2	40.5	28.3	24.9	26.6

Table III. **Per Cent of Saturation of the Air and Temperature of the Dew Point.**

Date.	October. Relative Humidity 7 a.m.	7 p.m.	Mean.	October. Dew Point 7 a.m.	7 p.m.	Mean.	November. Relative Humidity 7 a.m.	7 p.m.	Mean.	November. Dew Point 7 a.m.	7 p.m.	Mean.	December. Relative Humidity 7 a.m.	7 p.m.	Mean.	December. Dew Point 7 a.m.	7 p.m.	Mean.
1	40.4	31.0	35.7	27.0	22.4	24.7	95.3	94.3	94.8	33.1	23.0	28.0	43.7	73.3	58.5	19.8	23.7	21.7
2	42.9	38.2	40.5	23.3	25.8	24.5	100.	88.0	94.0	26.0	8.0	17.0	77.4	70.8	74.1	25.5	23.8	24.7
3	63.0	44.3	53.7	23.0	29.1	26.1	90.0	83.0	86.5	21.2	20.2	20.7	54.2	34.5	44.3	19.0	8.7	13.8
4	76.5	28.4	52.4	27.2	15.2	21.2	76.9	81.7	79.3	26.0	29.3	27.7	25.5	40.1	32.8	3.5	10.3	6.9
5	39.7	29.0	34.4	12.0	14.0	13.0	68.6	63.4	66.0	26.3	27.8	27.0	80.2	100.	90.1	19.8	15.0	17.4
6	41.5	35.5	38.5	13.0	25.5	19.2	66.4	69.0	67.7	15.8	12.7	14.3	97.6	100.	98.8	19.0	17.0	18.0
7	75.7	51.2	63.4	27.3	31.3	29.3	83.0	45.7	64.3	10.7	6.3	8.5	87.9	80.1	84.0	7.3	2.0	4.7
8	73.5	48.1	60.8	27.3	26.7	27.0	65.5	85.1	75.3	14.7	18.0	16.3	62.9	93.2	78.1	2.3	10.3	6.3
9	57.5	39.0	48.3	34.0	27.2	30.6	96.7	54.8	75.8	16.3	14.7	15.5	91.3	36.2	63.7	−0.5	−1.5	−1.0
10	71.4	56.7	64.0	36.1	26.8	31.5	50.7	50.6	50.6	16.5	23.8	20.2	69.5	69.0	69.3	5.5	7.0	6.2
11	45.8	100.	72.9	22.6	32.0	27.3	62.2	56.6	59.4	24.4	25.8	25.1	57.8	58.0	57.9	−1.0	−3.5	−2.3
12	......	......	......	......	......	......	45.7	52.9	49.3	19.0	25.3	22.1	88.5	49.7	69.1	−6.5	1.0	−2.7
13	......	......	......	......	......	......	79.5	44.6	62.1	11.5	9.7	10.6	78.1	90.5	84.3	2.3	9.0	5.7
14	62.6	75.6	69.1	23.8	26.0	24.9	13.3	34.0	23.6	−7.0	9.7	1.4	95.0	100.	97.5	1.5	−3.5	−1.0
15	69.9	56.3	63.1	16.8	25.2	21.0	64.3	40.0	52.2	6.3	3.3	4.8	36.6	83.6	60.1	−12.0	9.3	−1.3
16	39.3	78.0	58.7	19.2	30.0	24.6	76.0	49.2	62.6	13.0	2.6	7.8	90.3	79.5	84.9	9.7	−4.0	2.8
17	65.4	89.8	77.6	14.7	21.4	18.0	63.4	45.0	54.2	1.5	7.3	4.4	77.6	90.6	84.1	−10.5	2.3	−4.1
18	82.6	81.4	82.0	21.2	19.2	20.2	62.4	44.2	53.3	15.8	16.0	15.9	88.0	93.7	90.8	0.0	13.5	6.8
19	87.4	77.4	82.4	17.4	19.2	18.3	24.1	36.4	30.2	6.3	14.7	10.5	100.	93.0	96.5	6.2	8.3	7.2
20	97.0	46.4	71.7	14.0	14.7	14.4	45.8	61.2	53.5	14.7	16.0	15.4	88.6	79.2	83.9	5.5	−15.0	−4.7
21	96.7	84.8	86.2	18.5	22.6	20.5	38.2	37.9	38.1	10.3	15.0	12.6	63.3	44.3	53.8	−6.0	−8.0	−7.0
22	90.1	97.0	93.6	25.7	28.0	26.9	68.0	49.0	58.5	22.0	17.6	19.8	68.2	71.8	70.0	11.2	19.6	15.4
23	93.7	95.5	94.6	20.2	32.1	26.1	41.5	31.5	36.5	12.0	12.0	12.0	70.0	58.3	64.2	18.2	19.2	18.7
24	97.6	84.8	91.2	20.8	22.6	21.7	24.4	66.3	45.3	10.7	20.8	15.8	56.6	60.9	58.7	23.3	27.3	25.3
25	87.3	74.3	80.8	20.5	20.2	20.4	76.9	52.7	64.8	8.3	6.3	7.3	63.0	62.0	62.5	22.0	15.5	18.8
26	90.7	75.7	83.2	19.6	23.7	21.6	43.9	43.0	43.5	6.7	5.5	6.1	40.5	76.4	58.5	5.0	27.0	16.0
27	77.9	69.7	73.8	26.5	27.5	27.0	46.6	29.3	37.9	6.3	7.3	6.8	90.0	87.4	88.7	20.5	17.8	19.1
28	65.8	73.8	69.8	21.6	32.9	27.3	20.2	30.4	25.3	−4.0	13.5	4.7	82.0	46.7	64.3	11.2	12.3	11.8
29	62.1	76.5	69.3	25.8	27.2	26.5	48.4	40.0	44.2	20.8	15.0	17.9	67.0	48.6	57.8	15.0	0.5	7.7
30	78.4	......	......	27.2	......	......	28.9	31.6	30.3	7.7	10.7	9.2	98.9	35.2	67.1	10.3	−0.5	4.9
31	84.1	92.2	88.1	21.2	32.3	26.7							47.6	56.9	52.2	7.0	5.5	6.3
Sums.	2046.5	1830.6	1899.8	647.5	700.8	660.5	1766.8	1591.4	1679.1	412.9	437.9	425.4	2237.8	2163.5	2200.6	254.1	269.9	262.0
Means	70.6	65.4	67.8	22.3	25.0	23.6	58.9	53.0	56.0	13.8	14.6	14.2	72.2	69.8	71.0	8.2	8.7	8.4

Table IV.

WEEKLY MEANS OF SOIL TEMPERATURES, 1892.

WEEK ENDING.	AIR TEMP.	DEPTH. 3 INCHES	6 INCHES.	12 INCHES.	24 INCHES.	36 INCHES.	72 INCHES.
January 9	22.6	23.0	23.8	25.8	28.2	31.4	33.8
January 16	7.6	18.1	19.8	26.2	30.2	36.0	38.0
January 23	13.6	20.5	21.7	23.8	26.3	29.4	37.2
January 30	30.7	26.8	26.9	26.5	27.3	29.6	36.6
February 6	20.7	28.6	28.9	29.1	29.7	30.6	36.2
February 13	21.2	23.7	24.4	26.4	26.4	30.7	36.0
February 20	27.8	28.0	27.9	28.1	29.3	30.7	36.0
February 27	22.2	29.0	29.7	29.8	30.5	31.1	36.0
March 5	31.3	30.7	30.4	30.3	30.6	31.5	36.0
March 12	31.1	33.2	33.6	32.3	31.1	31.8	36.0
March 19	26.0	29.5	31.5	31.9	31.5	32.3	36.0
March 26	23.1	30.2	31.5	31.5	32.0	....	36.0
April 2	31.8	31.8	32.7	32.3	32.4	....	36.4
April 9	30.7	36.3	36.9	35.6	34.4	....	36.4
April 16	33.8	37.9	40.2	39.0	37.4	....	37.0
April 23	28.9	36.2	39.1	40.0	39.6	....	37.9
April 30	40.2	44.9	45.6	43.8	41.4	39.6	38.6
May 7	39.1	43.8	45.4	45.8	44.4	43.0	40.0
May 14	36.1	41.3	43.6	44.4	42.8	42.9	41.3
May 21	43.1	46.1	48.2	48.1	44.8	43.7	41.7
May 28	52.4	55.5	55.9	54.9	50.6	47.8	43.0
June 4	48.1	51.2	53.4	54.0	51.9	50.2	44.9
June 11	52.7	52.1	51.8	51.2	49.9	49.5	45.9
June 18	51.7	56.4	55.8	55.6	53.4	51.6	46.9
June 25	62.7	65.5	66.6	63.5	58.5	55.4	48.0
July 2	59.9	63.9	67.1	65.0	61.6	58.8	50.5
July 9	59.4	65.6	66.4	65.2	61.9	59.5	52.3
July 16	63.5	64.6	66.2	64.9	60.4	60.0	53.7
July 23	64.5	67.7	70.1	67.9	64.2	61.8	54.8
July 30	58.4	64.2	66.2	65.9	64.2	62.7	56.1
August 6	64.5	69.8	71.5	69.4	64.9	62.9	56.7
August 13	61.3	68.7	70.3	69.2	66.2	64.2	57.6
August 20	61.0	62.5	66.3	67.9	66.0	64.5	59.0
August 27	55.8	62.1	65.0	65.6	63.5	62.6	59.2
September 3	51.0	58.2	60.9	61.7	61.1	60.8	59.1
September 10	50.7	59.2	62.0	62.6	61.1	60.5	58.8
September 17	52.3	57.2	59.8	60.5	59.2	59.2	58.4
September 24	53.7	57.1	59.6	59.8	59.0	58.9	57.8
October 1	51.3	58.6	61.0	60.4	58.9	58.5	57.5
October 8	42.2	51.0	55.0	56.9	57.4	57.7	57.1
October 15	39.4	45.7	49.3	51.4	53.8	55.1	56.5
October 22	26.9	33.7	37.9	39.1	44.5	49.3	54.2
October 29	30.1	35.0	37.9	39.0	41.4	43.8	51.1
November 5	29.6	33.8	36.0	37.7	40.3	42.5	48.8
November 12	29.2	31.5	33.6	35.4	38.3	40.6	47.0
November 19	26.5	30.1	32.4	34.4	37.1	39.3	45.6
November 26	31.1	32.1	33.2	34.1	36.1	38.1	44.5
December 3	34.9	32.5	33.4	34.3	36.0	37.7	43.4
December 10	17.0	26.3	30.4	33.2	35.6	37.5	42.7
December 17	6.3	21.0	25.4	29.1	33.2	35.6	41.7
December 24	17.5	23.3	25.1	27.1	31.3	34.0	40.7
December 31	28.6	26.3	27.9	29.2	31.4	33.5	39.8
Sums	1995.8	2222.0	2315.2	2336.8	2323.2	2168.4	2376.4
Means	38.4	42.7	44.5	44.9	44.7	46.1	45.7

Table V. **ATMOSPHERIC PRESSURE.**

Date.	JANUARY.			FEBRUARY.			MARCH.			APRIL.		
	7 a. m	7 p. m.	Mean.	7 a. m.	7 p. m.	Mean.	7 a. m.	7 p. m.	Mean.	7 a. m.	7 p. m.	Mean.
1	23.059	23.167	23.113	22.884	22.009	22.946	22.958	22.934	22.946	22.703	22.764	22.733
2	23.203	23.155	23.179	23.032	23.184	23.108	22.935	22.955	22.945	22.762	22.648	22.705
3	23.077	22.912	22.994	23.117	22.953	23.035	22.968	22.957	22.962	22.493	22.466	22.480
4	22.750	22.712	22.731	22.837	22.866	22.852	22.893	22.801	22.847	22.545	22.862	22.703
5	22.692	22.961	22.827	22.763	22.697	22.730	22.832	22.843	22.838	23.101	23.038	23.070
6	22.941	22.888	22.914	22.656	22.688	22.672	23.058	23.051	23.054	23.079	23.080	23.079
7	22.790	22.754	22.772	22.681	22.758	22.719	23.082	23.048	23.065	23.034	23.029	23.032
8	22.875	22.856	22.866	22.842	22.921	22.882	22.915	22.812	22.864	23.219	23.147	23.183
9	22.821	22.809	22.815	22.861	22.649	22.755	22.901	23.103	23.002	23.153	23.017	23.085
10	22.725	22.818	22.771	22.722	22.760	22.741	23.200	23.197	23.198	22.914	22.949	22.931
11	22.867	22.865	22.866	23.011	23.056	23.033	23.131	23.109	23.120	22.993	22.914	22.954
12	22.970	22.963	22.967	22.993	22.775	22.884	23.125	23.124	23.125	22.913	22.967	22.940
13	23.004	22.914	22.959	22.586	22.562	22.574	23.099	23.013	23.056	23.154	23.241	23.197
14	22.961	22.931	22.946	22.698	22.857	22.778	22.959	23.073	23.016	23.227	23.092	23.160
15	23.022	22.934	22.978	22.993	23.098	23.045	23.005	22.881	22.943	22.984	22.895	22.939
16	22.814	22.820	22.817	23.177	23.139	23.158	22.891	23.001	22.946	22.888	22.829	22.859
17	22.823	22.927	22.875	23.063	23.020	23.042	23.057	23.072	23.064	22.799	22.738	22.768
18	22.956	22.963	22.959	22.921	22.884	22.902	22.986	22.881	22.934	22.785	22.854	22.820
19	22.799	22.857	22.828	22.861	22.813	22.837	22.808	22.708	22.758	22.907	22.951	22.929
20	23.022	23.070	23.046	22.945	23.017	22.981	22.666	22.729	22.697	22.989	23.066	23.027
21	22.907	22.947	22.927	23.116	23.121	23.119	22.667	22.786	22.727	23.081	23.055	23.068
22	23.134	23.211	23.173	23.087	23.015	23.051	22.879	22.940	22.909	23.033	23.001	23.017
23	23.339	23.227	23.283	23.076	23.236	23.156	22.940	22.894	22.917	22.915	22.905	22.910
24	23.279	23.197	23.238	23.298	23.235	23.266	22.877	22.807	22.842	22.959	22.881	22.920
25	23.143	23.060	23.101	23.180	23.045	23.113	22.816	22.869	22.843	22.963	22.916	22.940
26	22.970	22.966	22.968	22.953	22.857	22.905	22.978	23.012	22.995	22.798	22.864	22.831
27	23.100	23.080	23.090	22.931	23.121	23.026	23.024	22.896	22.960	23.005	23.133	23.069
28	23.084	23.158	23.121	23.122	23.163	23.142	22.712	22.585	22.648	23.158	23.107	23.132
29	23.214	23.169	23.192	23.028	23.009	23.019	22.713	22.900	22.807	23.005	22.893	22.949
30	23.111	22.907	23.009				22.839	22.642	22.740	22.910	22.768	22.839
31	22.682	22.728	22.705				22.506	22.543	22.525			
Sum	712.134	711.926	712.030	665.434	665.498	665.466	710.420	710.168	710.293	688.469	688.070	688.269
Mean.......	22.972	22.965	22.968	22.946	22.948	22.947	22.917	22.908	22.913	22.949	22.935	22.942

Table V.--Continued. **ATMOSPHERIC PRESSURE.**

Date.	MAY.			JUNE.			JULY.			AUGUST.		
	7 a. m.	7 p. m.	Mean.	7 a. m.	7 p. m.	Mean.	7 a. m.	7 p. m.	Mean.	7 a. m.	7 p. m.	Mean.
1	22.873	22.860	22.866	23.208	23.101	23.154	23.068	23.020	23.044	23.344	23.237	23.290
2	22.840	22.716	22.778	23.040	22.924	22.982	23.094	23.305	23.199	23.269	23.228	23.249
3	22.880	22.874	22.877	22.904	22.809	22.857	23.308	23.244	23.276	23.285	23.282	23.283
4	22.737	22.788	22.763	22.919	23.039	22.979	23.249	23.189	23.219	23.329	23.288	23.309
5	22.855	23.022	22.938	23.119	23.151	23.135	23.166	23.188	23.177	23.345	23.260	23.302
6	23.061	22.994	23.028	23.190	23.139	23.164	23.213	23.163	23.188	23.221	23.131	23.176
7	22.918	22.845	22.881	23.112	23.005	23.059	23.266	23.328	23.297	23.171	23.084	23.128
8	22.895	23.027	22.961	22.977	22.926	22.951	23.291	23.215	23.253	23.131	23.118	23.124
9	23.097	23.134	23.116	22.960	22.757	22.959	23.195	23.180	23.187	23.067	24.017	23.042
10	23.115	23.025	23.070	22.948	22.797	22.872	23.238	23.202	23.220	23.093	23.092	23.093
11	22.875	22.851	22.863	22.877	22.849	22.863	23.198	23.153	23.176	23.179	23.153	23.166
12	22.899	22.844	22.871	22.905	23.009	22.957	23.253	23.148	23.200	23.237	23.189	23.213
13	22.931	22.839	22.885	23.148	23.125	23.137	23.146	23.089	23.118	23.302	23.271	23.286
14	23.016	23.073	23.045	23.063	22.955	23.009	23.182	23.217	23.199	23.294	23.250	23.272
15	23.083	23.005	23.044	23.047	23.067	23.057	23.312	23.282	23.297	23.292	23.233	23.263
16	22.969	22.967	22.968	23.097	23.136	23.116	23.262	23.202	23.232	23.263	23.219	23.241
17	23.150	23.144	23.147	23.175	23.152	23.164	23.136	23.094	23.115	23.216	23.216	23.216
18	23.236	23.091	23.163	23.188	23.161	23.174	23.186	23.213	23.200	23.363	23.241	23.302
19	23.087	23.138	23.113	23.181	23.142	23.162	23.322	23.282	23.302	23.230	23.152	23.191
20	23.254	23.229	23.241	23.109	22.990	23.049	23.328	23.284	23.306	23.163	23.137	23.150
21	23.353	23.264	23.309	23.002	22.838	22.920	23.288	23.297	23.292	23.167	23.086	23.126
22	23.203	23.084	23.153	22.891	22.904	22.898	23.204	23.094	23.149	23.131	23.110	23.121
23	23.055	22.955	23.005	23.065	23.179	23.122	23.170	23.120	23.145	23.163	23.149	23.156
24	23.034	23.074	23.054	23.222	23.179	23.200	23.112	23.087	23.100	23.149	23.092	23.120
25	23.122	23.038	23.080	23.267	23.191	23.229	23.132	23.120	23.126	23.137	23.144	23.141
26	23.092	22.992	23.042	23.290	23.219	23.255	23.126	23.110	23.118	23.200	22.713	23.156
27	23.022	22.781	22.902	23.238	23.188	23.213	23.106	23.136	23.121	23.054	22.976	23.015
28	22.845	22.880	22.862	23.240	23.128	23.184	23.184	23.163	23.173	23.072	23.202	23.137
29	22.939	22.857	22.898	23.223	23.220	23.221	23.204	23.199	23.202	23.241	23.241	23.241
30	22.921	23.035	22.978	23.277	23.156	23.217	23.294	23.296	23.295	23.249	23.220	23.235
31	23.121	23.090	23.106				23.358	23.300	23.329	23.267	23.215	23.241
Sum	713.478	712.516	712.997	692.882	691.436	692.159	719.591	718.920	719.255	719.624	718.346	718.985
Mean......	23.015	22.984	23.000	23.096	23.048	23.072	23.213	23.191	23.202	23.214	23.172	23.193

Table V.--Concluded.

ATMOSPHERIC PRESSURE.

Date.	September. 7 a. m.	September. 7 p. m.	September. Mean.	October. 7 a. m.	October. 7 p. m.	October. Mean.	November. 7 a. m.	November. 7 p. m.	November. Mean.	December. 7 a. m.	December. 7 p. m.	December. Mean.
1	23.221	23.065	23.143	23.242	23.200	23.221	22.882	23.028	22.955	22.854	23.013	22.933
2	23.124	23.153	23.138	23.327	23.337	23.332	23.108	23.098	23.103	22.079	23.045	23.062
3	23.212	23.229	23.221	23.380	23.313	23.346	23.090	23.140	23.115	22.977	22.879	22.928
4	23.298	23.297	23.297	23.326	23.259	23.293	23.139	23.214	23.176	22.870	22.858	22.864
5	23.292	23.228	23.260	23.268	23.216	23.242	23.119	22.813	22.966	22.838	22.866	22.852
6	23.265	23.174	23.220	23.195	23.127	23.161	22.848	22.978	22.913	22.899	22.980	22.940
7	23.227	23.206	23.216	23.219	23.188	23.203	23.006	22.949	22.978	23.031	22.984	23.007
8	23.266	23.258	23.262	23.217	23.199	23.207	22.940	23.119	23.029	22.891	22.917	22.904
9	23.226	23.169	23.198	23.188	23.029	23.108	23.227	23 280	23.254	22.904	22.866	22.885
10	23.195	23.256	23.226	22.983	22.961	22.972	23.257	23.157	23.207	22.880	22.867	22.874
11	23.278	23.236	23.257	22.692	22.770	22.731	23.180	23.156	23.168	22.886	22.968	22.927
12	23.279	23.221	23.250	...	22.974	...	23.067	22.947	23.007	22.933	22.815	22.874
13	23.191	23.157	23.174	23.005	...	...	23.273	23.197	23.235	22.870	22.995	22.932
14	23.216	23.236	23.226	22.955	22.974	22.965	22.899	22.758	22.828	23.027	22.993	23.010
15	23.262	23.264	23.263	22.970	22.878	22.924	22.815	22.755	22.785	22.924	22.901	22.913
16	23.284	23.254	23.269	22.807	22.726	22.766	22.618	22.847	22.733	22.996	23.030	23.013
17	23.257	23.238	23.247	22.916	23.032	22.974	23.069	23.017	23.043	23.063	23.009	23.036
18	23.292	23.242	23.267	23.059	23.065	23.062	23.089	23.076	23.082	22.923	22.898	22.910
19	23.200	23.054	23.127	23.023	23.063	23.043	23.031	22.857	22.944	22.918	22.792	22.855
20	23.019	22.980	23.000	23.130	23.090	23.110	22.906	23.040	22.973	22.639	22.714	22.677
21	22.998	22.986	22.992	23.131	23.221	23.176	23.105	23.146	23.126	22.872	22.915	22.893
22	23.022	23.017	23.019	23.190	23.227	23.209	23.212	23.142	23.177	22.998	22.981	22.990
23	23.051	23.026	23.039	23.187	23.212	23.199	23.007	22.752	22.879	22.965	23.042	23.003
24	23.079	23.177	23.128	23.314	23.333	23.324	22.646	22 593	22.620	23.013	22.965	22.989
25	23.328	23.314	23.321	23.429	23.363	23.396	22.786	22.884	22.835	22.896	23.181	23.039
26	23.287	23.188	23.237	23.382	23.321	23.351	22.806	22.897	22.851	23.125	23.040	23.082
27	23.248	23.239	23.244	23.250	23.124	23.187	22.985	22.980	22.983	23.006	23.030	23.018
28	23.248	23.139	23.193	23.173	23.132	23.152	22.940	22.973	22.956	23.024	22.852	22.938
29	23.164	23.159	23.162	23.048	22.926	22.987	23.039	23.031	23.035	22.774	22.887	22.831
30	23.245	23.196	23.220	22.921	22.962	22.942	23.067	22.996	23.032	23.157	23.116	23.136
31				22.887	22.848	22.867				23.015	23.054	23.035
Sums... ...	696.274	695.358	695.826	693.814	693.067	670.450	690.156	689.820	689.988	711.247	711.453	711.350
Means.. ..	23.209	23.179	23.194	23.127	23.102	23.119	23.005	22.994	22.999	22.943	22.950	22.946

Table VI. **WIND.**

JANUARY.						FEBRUARY.					
	DIRECTION FROM.						DIRECTION FROM.				
DATE.	7 a.m.	Noon.	7 p.m.	Daily distance in miles.	Greatest velocity in mi. per hour.	DATE.	7 a.m.	Noon.	7 p.m.	Daily distance in miles.	Greatest velocity in mi. per hour.
1	sw	sw	s	385.9	32	1	n	s	s	145.7	20
2	se	sw	sw	492.3	40	2	w	w	ne	296.6	....
3	sw	.....	.....	583.4	42	3	sw	w	s	301.9	....
4	w	.....	w	980.1	**60**	4	s	s	s	90.1	....
5	nw	.....	nw	536.8	40	5	nw	s	s	99.7	16
6	sw	.....	s	566.1	....	6	n	n	n	39.9	12
7	w	.....	sw	592.4	40	7	s	n	n	85.5	16
8	o	sw	sw	205.4	20	8	s	o	s	265.1	24
9	s	w	w	369.1	36	9	w	w	nw	755.5	**60**
10	e	e	se	186.1	24	10	w	w	w	589.1	48
11	sw	sw	sw	237.8	28	11	w	w	w	402.6	32
12	o	o	se	154.1	....	12	w	w	sw	471.8	....
13	se	sw	sw	317.3	....	13	sw	sw	sw	240.8	....
14	sw	sw	sw	602.5	....	14	w	w	w	777.9	52
15	sw	sw	se	194.8	....	15	w	o	w	300.4	32
16	sw	ne	e	235.1	....	16	s	w	sw	360.2	32
17	ne	sw	se	70.5	....	17	sw	sw	sw	378.0	32
18	sw	e	sw	241.5	....	18	sw	sw	sw	301.2	30
19	sw	sw	sw	433.8	48	19	w	sw	sw	341.6	24
20	n	ne	sw	268.2	24	20	sw	w	sw	203.7	....
21	sw	sw	sw	301.4	32	21	s	s	s	252.5	24
22	ne	se	se	166.7	16	22	s	s	sw	194.5	24
23	se	se	se	152.0	....	23	nw	nw	nw	289.2	28
24	se	sw	sw	180.4	....	24	se	se	sw	71.3	18
25	s	se	s	33.8	...	25	se	o	o	28.0	4
26	se	se	se	290.3	....	26	n	ne	ne	251.2	36
27	nw	nw	n	135.2	28	27	n	ne	ne	274.9	40
28	ne	sw	sw	404.3	32	28	sw	sw	e	145.9	24
29	sw	sw	sw	204.0	24	29	s	s	s	180.5	20
30	se	s	sw	341.4	44						
31	e	e	ne	115.6	32						
Sum................				9979.3		Sum.				8135.3	
Daily mean.........				321.9		Daily mean.........				280.4	
Hourly mean........				13.4		Hourly mean........				11.7	

Table VI.--*Continued.* **WIND.**

MARCH.

DATE.	DIRECTION FROM. 7 a.m.	DIRECTION FROM. Noon.	DIRECTION FROM. 7 p.m.	Daily distance in miles.	Greatest velocity in mi. per hour.
1	se	se	se	276.2	24
2	se	sw	e	204.0	24
3	sw	sw	w	98.1	8
4	e	se	se	324.0	....
5	sw	nw	ne	325.7	....
6	n	n	n	201.5	20
7	nw	w	sw	235.7	32
8	sw	w	w	590.2	72
9	nw	nw	nw	341.4	30
10	sw	sw	sw	129.7	28
11	sw	.....	sw	468.1	40
12	sw	sw	sw	310.7	28
13	sw	n	o	179.5	24
14	e	e	e	341.3	36
15	se	sw	se	217.6	24
16	sw	nw	w	235.6	20
17	ne	.....	o	234.2	28
18	sw	w	sw	346.8	28
19	s	sw	s	326.8	28
20	o	n	ne	181.2	28
21	n	n	ne	291.5	36
22	w	nw	sw	228.0	28
23	se	sw	ne	614.2	24
24	se	w	sw	306.0	...
25	sw	n	sw	529.3	....
26	sw	sw	sw	515.0	40
27	sw	w	sw	707.0	44
28	s	.....	sw	507.5	44
29	w	w	sw	609.2	....
30	sw	....	sw	499.9	56
31	s	w	nw	657.0	48
Sum..............				11032.9	
Daily mean.........				355.9	
Hourly mean........				14.8	

APRIL.

DATE.	DIRECTION FROM. 7 p.m.	DIRECTION FROM. Noon.	DIRECTION FROM. 7 p.m.	Daily distance in miles.	Greatest velocity in mi. per hour.
1	w	w	sw	596.2	42
2	sw	w	o	214.9	24
3	se	.....	e	395.5	....
4	nw	nw	nw	545.1	42
5	se	se	se	554.5	....
6	s	sw	s	527.5	....
7	sw	sw	nw	553.5	54
8	s	sw	.....	268.9	26
9	sw	.....	nw	476.7	36
10	w	.....	w	538.9	54
11	sw	w	sw	343.2	30
12	e	e	e	450.3	48
13	ne	nw	nw	351.9	42
14	w	sw	sw	277.5	24
15	sw	sw	o	258.0	30
16	. .	.....	...	537.1	....
17	s	sw	sw	343.5	36
18	n	nw	ne	428.3	42
19	ne	ne	n	384.0	30
20	n	n	nw	247.5	....
21	ne	.....	...	806.5	....
22	w	.....	.	766.0	....
23	se	s	o	329.2	30
24	w	sw	sw	423.2	30
25	ne	.....	se	346.2	30
26	se	sw	sw	585.0	48
27	sw	w	w	318.0	42
28	s	sw	sw	333.5	24
29	sw	sw	sw	272.0	30
30	sw	sw	sw	445.7	30
Sum..............				12918.3	
Daily mean.........				430.6	
Hourly mean........				17.9	

Table VI.—*Continued.* **WIND.**

MAY.						JUNE.					
DATE.	DIRECTION FROM. 7 a.m.	Noon.	7 p.m.	Daily distance in miles.	Greatest velocity in mi. per hour.	DATE.	DIRECTION FROM. 7 a.m.	Noon.	7 p.m.	Daily distance in miles.	Greatest velocity in mi. per hour.
1	o	sw	sw	385.0	32	1	o	o	o	257.0	28
2	s	se	sw	478.0	60	2	sw	sw	sw	426.3	36
3	o	se	se	625.0	48	3	sw	ne	e	559.2	52
4	se	se	sw	533.0	66	4	nw	nw	nw	610.8	40
5	sw	w	sw	93.5	36	5	nw	nw	nw	308.2	....
6	o	sw	se	203.3	60	6	o	nw	o	285.3	....
7	se	se	s	620.2	64	7	sw	sw	sw	333.6	....
8	o	.....	ne	256.0	28	8	o	sw	se	317.1	48
9	w	nw	ne	188.0	20	9	se	se	se	310.0	40
10	s	nw	se	439.3	32	10	o	sw	sw	411.1	48
11	s	se	o	364.1	44	11	sw	sw	sw	408.1	44
12	o	o	e	263.9	36	12	sw	sw	.....	234.7	32
13	s	ne	e	368 2	40	13	sw	.....	sw	560.0	48
14	o	nw	w	247.0	20	14	se	.....	se	368.3	44
15	sw	w	o	336.1	...	15	se	.....	nw	252·1	36
16	o	o	nw	360.7	....	16	se	....	n	322.5	36
17	sw	ne	nw	556.5	....	17	se	.....	ne	261.9	18
18	nw	nw	w	559.6	48	18	se	.....	nw	225.8	28
19	nw	nw	ne	482.0	44	19	sw	.....	sw	351.5	28
20	nw	nw	nw	494.2	40	20	sw	.....	sw	371.3	28
21	o	se	se	165.6	18	21	sw	.....	sw	366.7	28
22	o	o	nw	189.8	20	22	sw	se	sw	728.4	52
23	sw	nw	e	389.8	36	23	.....	.....	ne	473.6	44
24	nw	nw	se	377.4	28	24	se	se	sw	408.4	....
25	sw	w	e	322.7	36	25	se	nw	sw	246.1	....
26	se	o	se	147.4	28	26	o	o	se	344.9	....
27	se	w	sw	583.7	48	27	se	nw	ne	308.6	....
28	sw	w	sw	551.0	40	28	sw	.....	nw	295.5	32
29	sw	.....	sw	397.3	32	29	w	nw	ne	293.7	36
30	o	o	ne	89.0	32	30	sw	se	se	225.7	36
31	o	.....	sw	457.7	28						
Sum...............				11525.0		Sum.				10876.4	
Daily mean.........				371.8		Daily mean.........				362.5	
Hourly mean........				15.5		Hourly mean..				15.1	

Table VI.--*Continued.* **WIND.**

JULY.						AUGUST.					
DATE.	DIRECTION FROM.			Daily distance in miles.	Greatest velocity in mi. per hour.	DATE.	DIRECTION FROM.			Daily distance in milles.	Greatest velocity in mi. per hour.
	7 a.m.	Noon.	7 p.m.				7 a.m.	Noon.	7 p.m.		
1	se	w	sw	479.6	44	1	sw	nw	sw	237.0	20
2	sw	nw	nw	334.4	44	2	ne	nw	sw	260.2	....
3	se	sw	sw	324.1	36	3	s	nw	se	211.7	....
4	sw	.....	e	222.6	28	4	o	.....	nw	186.4	....
5	sw	ne	sw	252.8	32	5	o	nw	sw	302.1	....
6	o	se	se	408.8	36	6	s	nw	s	231.1	....
7	w	.....	nw	285.2	40	7	o	nw	sw	258.7	32
8	o	se	o	190.4	28	8	se	nw	sw	192.4	36
9	se	se	o	226.6	36	9	o	o	sw	197.1	28
10	o	.....	se	225.1	50	10	sw	.....	sw	187.5	20
11	o	w	sw	242.9	32	11	sw	sw	sw	256.4	32
12	o	se	se	501.3	**52**	12	sw	sw	sw	225.2	24
13	se	.....	se	323.3	36	13	sw	o	ne	162.3	20
14	se	o	ne	450.9	....	14	sw	.....	o	214.9	20
15	s	s	s	537.4	48	15	se	nw	nw	229.2	30
16	s	o	s	233.1	36	16	o	.....	sw	207.9	30
17	s	.....	o	298.1	44	17	o	nw	se	406.0	**44**
18	o	nw	s	504.3	24	18	se	se	o	486.1	40
19	se	o	se	273.6	....	19	s	ne	se	246.4	24
20	sw	se	se	236.7	28	20	nw	se	se	454.7	**44**
21	o	se	o	214.5	28	21	sw	e	sw	344.1	40
22	sw	nw	sw	177.7	30	22	o	nw	sw	340.7	32
23	o	se	sw	394.3	44	23	o	ne	e	197.5	28
24	o	sw	sw	218.3	28	24	sw	ne	se	259.8	36
25	sw	se	o	226.2	32	25	sw	nw	w	335.9	36
26	o	o	se	263.0	36	26	sw	.....	sw	262.4	24
27	nw	se	sw	248.1	28	27	sw	nw	nw	69.1	....
28	se	se	se	298.7	32	28	ne	nw	ne	472.3	24
29	o	.....	sw	163.2	24	29	o	w	o	374.7	....
30	sw	nw	ne	189.0	24	30	sw	nw	nw	151.2	....
31	o	.....	ne	188.7	32	31	sw	nw	se	164.0	20
Sum...............				9132.9		Sum...............				8125.0	
Daily mean.........				294.6		Daily mean.........				262.1	
Hourly mean..				12.3		Hourly mean........				10.9	

Table VI.—*Continued.* **WIND.**

SEPTEMBER.						OCTOBER.					
DATE.	DIRECTION FROM. 7 a.m.	Noon.	7 p.m.	Daily distance in miles.	Greatest velocity in mi. per hour.	DATE.	DIRECTION FROM. 7 a.m.	Noon.	7 p.m.	Daily distance in miles.	Greatest velocity in mi. per hour.
1	o	sw	nw	183.4	24	1	o	.....	o	369.3	....
2	o	.....	o	251.2	28	2	o	.....	se	241.1	20
3	sw	o	sw	226.4	32	3	o	.... .	se	175.7	....
4	o	ne	ne	281.2	36	4	o	ne	se	91.1	....
5	sw	sw	o	234.9	24	5	o	.....	se	102.1	12
6	sw	w	sw	287.4	24	6	o	.....	e	223.6	44
7	se	nw	e	404.5	40	7	o	sw	sw	413.9	40
8	ne	.....	se	207.1	20	8	s	.....	o	160.1	24
9	se	.....	se	112.3	32	9	sw	sw	se	257.9	....
10	ne	.....	n	475.8	24	10	sw	sw	se	202.4	20
11	o	ne	n	375.1	24	11	se	nw	nw	....	...
12	o	ne	se	145.0	16	12	nw	nw	nw	592.0	**48**
13	o	.....	e	193.5	32	13	sw	.....	o	185.0	28
14	se	n	se	172.2	24	14	sw	.....	o	....	..
15	s	e	ne	221.1	24	15	s	.....	.....	302.4	....
16	s	se	s	159.8	24	16	se	o	nw	372.2	32
17	sw	sw	se	181.1	40	17	sw	w	nw	415.1	32
18	se	o	o	138.1	36	18	nw	sw	ne	279.9	20
19	se	se	s	298.8	36	19	se	ne	ne	97.0	12
20	s	.....	nw	358.2	40	20	se	.....	o	134.9	24
21	sw	.....	se	280.7	28	21	o	o	o	120.0	28
22	o	sw	sw	332.9	32	22	sw	se	se	233.9	24
23	sw	sw	sw	397.1	36	23	o	ne	o	127.1	24
24	s	sw	sw	387.9	**44**	24	se	se	se	98.9	12
25	sw	.....	s	162.0	....	25	se	nw	nw	124.7	24
26	o	.....	s	182.5	....	26	se	se	se	148.6	16
27	se	sw	s	260.2	....	27	se	ne	se	555.4	40
28	o	se	se	256.9	....	28	se	e	se	369.4	40
29	sw	sw	se	177.1	16	29	se	se	se	120.1	28
30	o	.....	sw	222.0	24	30	nw	ne	ne	166.1	20
						31	se	w	ne	166.3	20
Sum..............				7566.4		Sum..............				6846.2	
Daily mean.........				252.2		Daily mean.........				236.1	
Hourly mean........				10.5		Hourly mean........				9.8	

Table VI.—*Concluded.* **WIND.**

NOVEMBER.

DATE.	Direction from. 7 a.m.	Direction from. Noon.	Direction from. 7 p.m.	Daily distance in miles.	Greatest velocity in mi. per hour.
1	n	ne	o	180.5	20
2	n	ne	o	114.1	20
3	sw	e	se	187.5	16
4	se	o	se	194.7	22
5	se	.....	se	548.8	28
6	w	nw	nw	565.0	**54**
7	sw	sw	sw	311.1	26
8	sw	ne	sw	184.6	24
9	o	ne	sw	230.4	24
10	sw	w	sw	352.6	40
11	sw	.....	sw	417.0	28
12	s	sw	sw	485.4	....
13	se	nw	s	261.1	30
14	sw	sw	nw	468.6	40
15	sw	sw	sw	335.1	28
16	sw	w	nw	597.9	56
17	nw	nw	sw	595.5	40
18	se	sw	sw	620.7	40
19	sw	sw	s	658.2	48
20	nw	sw	se	335.6	32
21	s	w	sw	476.6	36
22	se	se	se	319.8	24
23	sw	sw	se	309.3	24
24	se	se	sw	598.3	40
25	sw	sw	sw	404.3	46
26	sw	sw	sw	297.9	24
27	nw	nw	sw	374.1	28
28	sw	sw	s	581.6	48
29	w	sw	se	482 6	36
30	sw	sw	s	391.1	30
Sum				11870.0	
Daily mean				395.7	
Hourly mean				16.5	

DECEMBER.

DATE.	Direction from. 7 a.m.	Direction from. Noon.	Direction from. 7 p.m.	Daily distance in miles.	Greatest velocity in mi. per hour.
1	s	s	ne	410.0	....
2	sw	nw	sw	201.7	24
3	sw	sw	sw	302.8	32
4	se	sw	s	277.4	44
5	ne	ne	ne	289.3	30
6	nw	n	ne	384.5	....
7	nw	nw	ne	289.3	30
8	ne	nw	nw	397.1	36
9	se	n	sw	179.6	24
10	ne	se	s	412.6	**48**
11	o	n	o	74.6	15
12	se	s	sw	233.5	24
13	ne	n	ne	151.3	16
14	s	s	se	283.9	24
15	w	w	n	334.4	36
16	n	n	n	120.7	24
17	s	n	s	188.5	16
18	s	n	n	135.7	16
19	sw	nw	sw	123.5	24
20	ne	nw	o	146.7	24
21	sw	se	sw	237 6	24
22	sw	.....	s	330.6	30
23	se	s	sw	390.5	24
24	sw	s	sw	481.8	42
25	w	nw	sw	455.5	**48**
26	sw	sw	sw	419.0	36
27	nw	n	n	309.7	36
28	se	.....	s	389.3	36
29	sw	s	w	375.7	24
30	ne	o	w	314.7	30
31	sw	nw	sw	469.6	36
Sum				9111.1	
Daily mean				293.9	
Hourly mean				12.2	

SUMMARY.

Highest temperature, 86.0, August 14 and 16. Warmest day (for 24 hours) July 20.

Lowest temperature, —29.0, January 11. Coldest day (for 24 hours), January 11.

Mean temperature for the year, 40.5; for 1891, 40.9.

Greatest daily range of temperature, 44.0, October 3.

Lowest daily range, 1.3, December 16.

Mean daily range of temperature for the year, 23.9.

Mean relative humidity for the year, 63.7.

Lowest relative humidity, 13.3, November 14.

Highest dew point, 55.5, June 22.

Lowest dew point, —21.0, January 11.

Mean dew point for year, 24.6.

Greatest terrestrial radiation, 9.1, December 22.

Mean terrestrial radiation for year, 3.2.

Highest barometer, 23.382, October 26.

Lowest barometer, 22.466, April 3.

Mean barometer for the year, 23.041.

Highest monthly precipitation, 3.97, in June.

Lowest monthly precipitation, traces in September and November.

Highest precipitation during any single storm, 3.90 inches, June 4 and 5.

Total precipitation, 12.73 inches; in 1891, 13.92 inches.

Evaporation, 34.91 inches, from May 24 to October 10.

Greatest monthly evaporation, 9.19 inches, in July.

Mean soil temperatures—3 in., 42.7; 6 in., 44.5; 12 in., 44.9; 24 in., 44.7; 36 in., 46.1; 72 in., 45.7.

Prevailing direction of the wind, southwest.

Greatest velocity of wind, 72 miles per hour, March 8.

Total number of miles traveled by wind in year, 117118.8.

Greatest number of miles traveled in one month, 12918.3, in April.

Lowest number of miles traveled in one month, 6846.2, in October.

Average number of miles for each month, 9759.9.

Greatest number of miles in one day, 980.1, January 4.

Least number of miles in one day, 28.0, February 25.

Mean daily distance traveled, 320 miles.

Mean hourly distance, 13.3 miles.

Frosts, June 5, 6, 7 and 13.

Killing frost, August 29.

Table VII.

TEMPERATURE AT LANDER, 1892.

JANUARY.

Date.	7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range
1	3	18	17.5	36	−1	37
2	12	29	27.5	47	8	39
3	29	42	38.5	53	24	29
4	31	30	38.0	51	25	26
5	17	10	20.0	31	9	22
6	−6	10	11.0	30	−8	38
7	15	23	23.5	41	6	35
8	1	10	14.5	30	−1	31
9	1	4	10.5	25	−4	29
10	−4	8	−4.0	6	−10	16
11	......	12	−8.0	10	**−26**	36
12	......	−11	−4.0	13	−21	34
13	6	0	2.0	20	−16	36
14	0	22	14.5	38	−9	47
15	18	26	26.5	45	8	37
16	20	......	30.0	47	13	34
17	8	3	12.0	24	0	24
18	......	−3	1.0	20	−18	38
19	16	26	20.5	48	−7	**55**
20	14	16	26.0	44	8	36
21	13	20	25.5	43	8	35
22	19	17	24.5	42	7	35
23	10	17	22.5	40	5	35
24	9	20	25.0	45	5	40
25	10	19	23.0	42	4	38
26	8	35	28.5	44	13	31
27	30	26	36.0	49	23	26
28	14	28	31.5	51	12	39
29	25	36	38.0	56	20	36
30	28	39	41.0	**58**	24	34
31	33	27	32.5	40	25	**15**
Sum .	380	559	645.5	1169	126	1043
Mean.	13.6	18.6	20.8	37.7	4.0	33.6

FEBRUARY.

Date.	7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.
1	25	22	28.5	37	20	17
2	10	24	22.5	38	7	31
3	5	13	20.5	39	2	37
4	13	16	20.5	32	9	23
5	10	17	18.0	30	6	24
6	19	5	19.5	31	8	23
7	2	4	18.0	29	7	22
8	0	3	20.5	35	6	29
9	2	21	19.5	36	3	33
10	15	36	28.5	51	6	**45**
11	26	38	29.0	48	10	38
12	23	36	35.0	51	19	32
13	20	23	31.5	48	15	33
14	13	21	24.0	32	16	**16**
15	7	28	23.5	39	8	31
16	11	32	28.5	44	13	31
17	17	36	31.0	46	16	30
18	25	29	35.5	48	23	25
19	22	41	36.5	50	23	27
20	27	41	36.0	50	22	28
21	26	40	41.5	**52**	31	21
22	31	40	41.0	51	31	20
23	24	36	29.5	42	17	25
24	18	37	29.0	44	14	30
25	18	37	35.5	50	21	29
26	21	42	34.5	45	24	21
27	28	36	36.0	48	24	24
28	22	42	34.0	46	22	24
29	26	47	38.5	**52**	25	27
Sum .	506	843	846.0	1244	448	796
Mean.	17.4	29.0	30.2	44.4	16.0	27.5

MARCH.

Date.	7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.
1			37.5	49	26	23
2			40.0	53	27	26
3			40.0	49	31	18
4			37.5	51	24	27
5			39.0	50	28	22
6			34.5	46	23	23
7			37.5	51	24	27
8			46.0	61	31	30
9			30.5	37	24	**13**
10			36.5	55	18	37
11			45.5	65	26	**39**
12			47.0	**66**	28	38
13			42.5	56	29	27
14			32.5	44	21	23
15			24.5	34	15	19
16	No readings.	No readings.	17.0	27	7	20
17			14.0	32	**−4**	36
18			24.0	40	8	32
19			33.0	46	20	26
20			32.0	42	22	20
21			30.0	39	21	18
22			39.0	54	24	30
23			39.0	52	26	26
24			38.0	53	23	30
25			34.5	45	24	21
26			32.0	48	16	32
27			36.5	54	19	35
28			41.5	56	27	29
29			39.0	53	25	28
30			40.5	52	29	23
31			37.5	50	25	25
Sum .	......	......	1098.5	1510	697	813
Mean.	......	......	35.4	48.6	22.4	26.3

Table VII.--Continued. TEMPERATURE AT LANDER, 1892.

	APRIL.						MAY.						JUNE.					
Date.	7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.	7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.	7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.
1			35.0	55	15	40	47	44	49.0	63	35	28	......	67	56.0	75	37	**38**
2			37.5	54	21	33	35	29	35.5	44	27	17	63	62	63.5	75	52	23
3			38.0	51	25	26	35	37	33.0	46	20	26	44	35	34.5	36	33	**3**
4			36.5	45	28	17	37	32	36.0	48	24	24	35	46	38.5	46	**31**	15
5			34.5	53	16	37	34	36	30.0	49	**11**	38	52	55	48.5	61	36	25
6			43.5	63	24	39	50	38	39.0	49	29	20	55	63	57.5	73	42	31
7			43.0	59	27	32	38	39	40.0	48	32	**16**	60	71	61.5	80	43	37
8			33.5	48	19	29	37	40	42.5	54	31	23	66	63	66.0	75	57	18
9			44.0	62	26	36	43	47	45.0	60	30	30	53	69	60.0	77	43	34
10			47.0	65	29	36	46	50	46.0	60	32	28	54	49	51.0	58	44	14
11			45.0	65	25	40	42	44	45.0	59	31	28	49	52	48.5	57	40	17
12			34.5	47	22	25	44	44	44.5	62	27	35	49	44	46.5	52	41	11
13			32.5	54	11	**43**	36	39	39.0	47	31	**16**	50	54	47.0	63	**31**	32
14			41.5	58	25	33	47	49	47.0	64	30	34	53	64	57.0	75	39	36
15			49.5	66	33	33	56	56	55.5	76	35	41	53	51	55.0	65	45	20
16	No readings.	No readings.	49.5	67	32	35	50	52	55.0	69	41	28	48	51	50.0	60	41	19
17			46.0	63	29	34	50	55	53.5	75	32	**43**	59	65	59.5	75	44	31
18			38.0	46	30	**16**	49	50	52.5	72	33	39	62	67	63.0	78	48	30
19			34.0	43	25	18	52	47	53.0	70	36	34	65	......	65.0	80	50	30
20			31.5	42	21	21	59	46	48.0	68	28	40	......	......	66.0	83	49	34
21			28.0	46	**10**	36	43	55	49.5	71	28	**43**	73	74	59.5	74	45	29
22			37.5	55	20	35	60	62	50.5	62	39	23	48	61	58.5	73	44	29
23			44.0	60	28	32	58	61	60.0	75	45	30	51	58	59.0	74	44	30
24			41.0	61	21	40	55	55	60.5	76	45	31	51	62	56.5	73	40	33
25			46.0	60	32	28	55	58	62.0	80	44	36	61	70	67.0	**85**	49	36
26			37.5	46	29	17	56	67	60.5	**81**	40	41	62	70	65.5	82	49	33
27			39.5	55	24	31	53	62	62.5	74	51	23	62	68	68.5	83	54	29
28			39.0	60	18	42	56	55	55.5	71	40	31	64	75	69.0	**85**	53	32
29			50.5	**72**	29	**43**	56	51	52.5	69	36	33	70	71	73.5	83	64	19
30			50.0	68	32	36	36	39	39.5	49	30	19	66	73	67.5	80	55	25
31							42	55	47.5	65	30	35						
Sum	......	......	1207.5	1689	726	963	1457	1494	1489.5	1956	1023	958	1578	1700	1730.5	2136	1343	793
Mean	......	......	40.2	56.3	24.2	32.1	47.0	48.3	48.1	63.0	33.3	30.9	56.4	60.7	57.9	71.5	44.7	26.4

Table VII.--Continued. **TEMPERATURE AT LANDER, 1892.**

	JULY.						AUGUST.						SEPTEMBER.					
Date.	7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.	7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.	7 a.m.	6 p.m.	Mean.	Max.	Min.	Daily Range.
1	67	61	66.5	75	58	17	68	60	73.5	**92**	55	**37**	56	73	68.5	84	53	31
2	59	65	53.0	61	45	16	66	79	76.5	90	63	27	54	65	62.5	73	52	21
3	58	74	59.0	75	**43**	32	71	80	75.0	89	61	28	50	66	58.5	72	45	27
4	69	71	71.5	83	60	23	76	74	72.0	82	62	20	50	60	59.0	76	42	34
5	69	78	70.0	80	60	20	66	77	71.5	89	54	35	58	68	62.5	80	45	35
6	70	70	77.0	87	67	20	73	61	74.5	89	60	29	61	64	64.0	80	48	32
7	66	67	68.0	81	55	26	66	60	71.5	86	57	29	50	62	60.5	76	45	31
8	62	70	64.0	81	47	34	62	64	63.0	76	50	26	40	59	57.5	71	44	27
9	64	75	69.0	82	56	26	59	65	62.0	77	47	30	56	61	59.0	73	45	28
10	68	72	67.5	82	53	29	64	73	68.5	84	53	31	47	54	57.5	73	42	31
11	73	69	72.5	79	66	13	66	70	64.5	72	57	**15**	40	60	54.5	74	**35**	30
12	62	70	67.5	84	51	33	65	72	70.5	84	57	27	56	65	64.5	77	52	25
13	64	70	69.5	84	55	29	72	75	73.5	87	60	27	40	66	63.0	81	45	36
14	61	70	66.0	80	52	28	65	76	68.5	80	57	23	60	69	67.0	79	55	24
15	63	77	67.5	85	50	35	76	80	79.0	91	67	24	53	69	62.5	79	46	33
16	60	73	73.5	87	60	27	84	72	76.0	88	64	24	59	72	68.5	81	56	25
17	70	76	71.5	83	60	23	72	67	75.0	86	64	22	64	66	60.5	76	45	31
18	68	76	70.0	87	53	**34**	52	64	59.0	76	42	34	56	71	66.0	80	52	28
19	72	77	70.0	80	60	20	65	71	68.5	85	52	33	54	70	66.0	80	52	28
20	71	75	77.5	88	67	21	56	67	63.0	76	50	26	56	55	60.5	72	49	23
21	71	75	70.0	79	61	18	56	64	57.5	70	45	25	44	65	55.5	72	39	33
22	72	71	71.5	80	63	17	50	64	62.0	74	50	24	59	67	63.5	72	55	17
23	67	73	74.5	**90**	59	31	57	62	61.0	77	45	32	61	68	67.5	75	60	15
24	68	71	69.5	85	54	31	63	72	64.0	80	48	32	59	63	62.5	69	56	**13**
25	69	72	70.5	86	55	31	65	77	66.0	79	53	26	47	65	60.0	76	44	32
26	68	69	72.5	85	60	25	69	66	69.0	81	57	24	53	65	65.5	80	51	29
27	56	58	62.5	76	49	27	65	50	60.0	70	50	20	54	63	62.5	76	49	27
28	57	60	61.5	63	60	**3**	42	49	51.5	65	**38**	27	49	67	68.5	**89**	48	**41**
29	57	65	61.5	75	48	27	54	56	53.0	68	**38**	30	57	62	67.0	79	55	24
30	62	66	67.0	82	52	30	61	67	62.5	80	45	35	52	60	64.5	80	49	31
31	69	82	75.0	89	61	28	65	70	68.0	82	54	28						
Sum .	2041	2198	2127.0	2514	1740	774	2000	2113	2080.0	2505	1655	850	1613	1949	1879.5	2305	1454	851
Mean.	65.8	70.9	68.6	81.1	56.1	24.9	64.5	68.2	67.1	80.8	53.4	27.4	53.8	65.0	62.7	76.8	48.4	28.4

Table VII.--Concluded. TEMPERATURE AT LANDER, 1892.

	OCTOBER.						NOVEMBER.						DECEMBER.					
Date.	6 a.m.	8 p.m.	Mean.	Max.	Min.	Daily Range.	6 a. m.	6 p.m.	Mean.	Max.	Min.	Daily Range.	6 a. m.	7 p.m.	Mean.	Max.	Min.	Daily Range.
1	52	60	60.0	72	48	24	35	32	37.5	45	30	15	45	39	45.5	**53**	38	15
2	47	60	58.5	72	45	27	32	35	32.0	39	25	14	31	32	36.5	52	21	31
3	50	62	60.0	72	48	24	30	42	38.5	51	26	25	32	45	36.5	50	23	27
4	54	60	63.5	**75**	52	23	41	49	45.0	55	35	20	42	39	36.0	50	22	28
5	55	64	63.0	73	53	20	34	45	47.5	**61**	34	27	36	32	32.5	40	25	15
6	55	63	63.5	74	53	21	32	31	39.5	55	24	31	30	31	19.5	26	13	13
7	46	57	53.0	64	42	22	29	32	35.5	55	16	39	22	25	17.5	24	11	13
8	42	57	54.5	69	40	29	30	29	30.5	39	22	17	28	30	14.0	27	1	26
9	48	64	57.5	69	46	23	32	33	34.0	47	21	26	30	25	13.0	19	7	12
10	49	57	54.5	65	44	21	34	45	38.5	56	21	35	24	24	13.5	25	2	23
11	47	38	48.0	64	32	32	35	45	46.0	60	22	28	15	20	11.0	-4	26	30
12	37	38	39.0	46	32	14	46	43	46.5	59	34	25	11	22	4.0	15	-7	22
13	35	42	44.0	54	34	20	28	35	42.0	59	25	34	28	29	12.5	21	4	17
14	34	47	46.0	60	32	28	49	35	37.5	50	25	25	24	25	9.0	20	-2	22
15	35	60	48.5	65	32	**33**	30	33	33.0	50	16	34	25	21	11.5	28	-5	33
16	37	39	48.5	65	32	**33**	30	31	35.0	30	20	**10**	26	25	16.5	24	9	15
17	32	32	31.0	40	22	18	30	30	22.5	35	10	25	21	13	13.0	25	1	24
18	32	30	34.0	47	**21**	26	32	39	35.0	50	20	30	18	23	12.5	25	0	25
19	20	36	32.0	43	**21**	22	40	51	43.5	57	30	27	24	20	16.0	22	10	12
20	32	40	40.0	50	30	20	33	30	38.0	53	23	30	20	......	3.0	12	-6	18
21	30	41	39.5	52	27	25	32	35	37.0	53	21	32	20	20	-4.0	13	**-21**	34
22	34	44	42.5	53	32	21	35	48	38.0	55	21	34	15	36	7.5	36	**-21**	**57**
23	35	45	46.0	60	32	28	35	55	46.0	60	22	28	44	35	47.5	50	45	**5**
24	40	45	48.0	58	38	20	48	30	30.0	55	23	32	48	45	39.5	50	20	21
25	39	42	46.0	55	37	18	11	29	30.0	55	**5**	**50**	30	35	41.5	52	31	21
26	41	47	49.5	65	34	31	26	27	19.5	32	7	25	32	35	20.0	37	21	16
27	44	52	47.0	60	34	26	32	22	22.0	33	11	22	56	29	37.0	48	26	22
28	46	44	48.0	61	35	26	40	45	28.5	45	12	33	20	22	24.0	33	15	18
29	37	48	48.5	62	35	27	44	48	39.0	51	27	24	31	30	27.0	34	20	14
30	44	43	48.5	55	42	**13**	43	49	44.5	55	34	21	28	30	18.0	28	8	20
31	38	46	42.0	52	32	20							30	30	27.0	37	17	20
Sum	1276	1512	1504.5	1872	1137	735	1037	1133	1091.0	1500	682	818	904	867	667.5	1002	333	669
Mean.	41.2	48.8	48.5	60.4	36.7	23.7	34.6	37.8	36.4	50.0	22.7	27.3	20.2	28.9	21.5	32.3	10.8	21.6

Table I III. **Per Cent of Saturation of Air and Temperature of Dew Point at Lander.**

Date.	JANUARY.						FEBRUARY.						MAY.					
	RELATIVE HUMIDITY			DEW POINT			RELATIVE HUMIDITY			DEW POINT			RELATIVE HUMIDITY			DEW POINT		
	7 a.m.	7 p.m.	Mean.	7 a.m.	7 p.m.	Mean.	7 a.m.	7 p.m.	Mean.	7 a.m.	7 p.m.	Mean.	7 a.m.	7 p.m.	Mean.	7 a.m.	7 p.m.	Mean.
1	79.0	59.7	69.3	—2.0	5.0	1.5	90.4	88.8	89.6	22.4	19.4	20.9	49.3	47.9	48.6	29.1	25.3	27.2
2	66.0	42.4	54.2	3.0	8.7	5.8	100	76.8	88.4	10.0	17.6	13.8	83.0	90.8	86.9	30.4	26.3	28.3
3	42.4	44.6	43.5	8.7	21.8	15.3	81.0	100	90.5	0.0	13.0	6.5	94.6	76.8	85.7	32.9	29.7	31.3
4	74.0	53.5	63.8	23.0	15.2	19.1	88.1	71.0	79.5	9.7	8.0	8.8	38.0	100	69.0	13.8	32.0	22.9
5	89.8	100	94.9	14.7	10.0	12.3	84.0	85.5	84.8	6.0	13.5	9.8	42.3	83.6	62.9	12.7	31.4	22.1
6	100	100	100	—6.0	10.0	2.0	86.5	100	93.2	15.5	5.0	10.2	24.9	100	62.5	16.8	38.0	27.4
7	85.0	65.2	75.1	11.5	13.5	12.5	100	80.0	90.0	2.0	—1.0	0.5	77.8	100	88.9	31.7	39.0	35.3
8	100	84.0	92.0	1.0	6.0	3.5	100	79.0	89.5	0.0	—2.0	—1.0	83.6	64.8	74.2	32.4	35.4	33.9
9	54.0	100	77.0	—4.5	4.0	0.3	100	52.0	76.0	2.0	6.0	4.0	53.0	69.0	61.0	27.0	37.0	32.0
10	100	100	100	4.0	8.0	6.0	70.0	51.4	60.7	7.0	20.2	13.6	49.9	69.6	59.7	28.3	40.8	34.6
11	....	100	.....	......	12.0	......	80.8	55.0	67.9	20.8	23.0	21.9	79.4	59.8	69.6	35.6	30.4	33.0
12	....	100	......	......	—11.0	.....	76.4	61.0	68.7	16.8	23.5	20.2	23.7	59.8	41.8	8.7	30.4	19.5
13	100	100	100	6.0	0.0	3.0	87.7	65.2	76.5	16.5	13.5	15.0	69.4	77.8	73.6	26.2	32.7	29.5
14	100	65.2	82.6	0.0	11.5	5.7	88.1	76.0	82.0	9.7	15.0	12.3	33.2	57.8	45.5	19.2	34.5	26.8
15	87.1	80.2	83.6	14.7	20.8	14.8	60.0	51.0	55.5	—4.0	11.5	3.8	57.9	68.0	62.9	41.3	45.0	43.2
16	87.7	....	......	16.5	......	......	23.7	66.5	75.1	6.7	21.6	14.1	69.6	48.3	59.0	40.8	33.1	36.9
17	....	53.0	......	......	—10.0	......	57.0	61.0	59.0	3.5	23.5	13.5	46.9	50.4	48.6	30.3	36.7	33.5
18	....	70.0	......	......	—10.0	......	78.4	72.0	75.2	18.8	23.8	21.3	40.5	75.8	58.2	26.0	42.6	34.3
19	100	80.0	90.0	16.0	20.8	18.4	75.8	58.0	66.9	15.8	26.7	21.3	34.7	49.3	42.0	24.8	29.1	27.0
20	100	100	100	14.0	16.0	15.0	80.6	58.0	69.3	21.6	26.7	24.1	51.4	37.7	44.5	40.8	21.8	31.3
21	100	63.9	82.0	13.0	8.7	10.8	80.8	78.4	79.6	20.8	33.6	27.2	53.0	53.4	53.2	27.0	37.8	32.4
22	61.0	85.5	73.2	6.8	13.5	10.2	81.5	49.2	65.4	25.5	22.6	24.1	48.0	53.2	50.6	40.0	44.6	42.3
23	100	72.0	86.0	10.0	9.0	9.5	66.5	51.4	68.9	14.3	20.2	17.2	57.8	46.2	50.2	43.2	38.3	40.7
24	62.0	63.9	62.9	—1.5	8.7	3.6	48.9	61.8	55.4	5.0	24.4	14.7	64.8	53.4	59.1	43.9	37.8	40.9
25	65.0	86.5	75.8	0.5	15.5	8.0	73.0	61.8	67.4	11.0	24.4	17.7	52.2	46.3	49.3	37.8	37.2	37.5
26	62.3	58.5	60.4	—2.5	21.8	9.6	89.5	44.6	67.0	18.5	21.8	20.2	43.0	30.8	36.9	33.5	34.8	34.1
27	61.7	68.6	65.2	18.5	17.2	17.9	81.0	61.0	71.0	22.6	23.5	23.0	66.0	25.5	45.7	42.0	25.5	33.8
28	69.9	51.0	60.4	6.3	11.5	8.9	75.8	63.2	69.5	15.8	30.1	23.0	43.0	53.4	48.2	33.5	37.8	35.6
29	68.2	51.4	59.8	15.5	20.2	17.8	80.8	39.2	60.0	20.8	23.5	22.1	63.2	44.5	53.9	43.1	29.7	35.4
30	81.0	64.2	72.6	22.6	27.3	25.0							83.6	92.8	88.2	31.4	37.2	34.3
31	75.0	80.6	77.8	25.8	21.6	23.7							59.0	47.6	53.3	27.7	35.1	31.4
Sums.	2101.1	2313.9	2002.1	232.6	327.3	281.2	2346.4	1918.8	2132.6	355.1	552.6	443.8	1736.7	1930.7	1833.7	951.9	1067.0	1009.4
Means	77.8	77.1	77.0	8.6	10.9	10.8	80.9	66.2	73.5	12.2	18.7	15.3	56.0	62.3	59.1	30.7	34.4	32.6

Table VIII. **Per Cent of Saturation of Air and Temperature of Dew Point at Lander.**

Date.	JUNE.						JULY.						AUGUST.					
	RELATIVE HUMIDITY			DEW POINT			RELATIVE HUMIDITY			DEW POINT			RELATIVE HUMIDITY			DEW POINT		
	7 a.m.	7 p.m.	Mean	7 a.m.	7 p.m.	Mean	7 a.m.	7 p.m.	Mean.	7 a.m.	7 p.m.	Mean.	7 a.m.	7 p.m.	Mean.	7 a.m.	7 p.m.	Mean.
1	......	76.8	......	......	59.4	......	45.0	46.8	45.9	45.0	40.9	42.9	52.8	84.6	68.7	50.4	55.3	52.8
2	65.8	37.0	51.4	51.6	35.0	43.0	51.4	44.2	47.8	40.8	42.1	41.5	42.0	31.0	36.5	43.0	46.0	44.5
3	73.6	63.8	68.7	35.9	28.3	32.1	73.8	38.4	56.1	49.6	47.2	48.4	50.8	27.8	39.3	52.4	42.6	47.5
4	63.8	100	81.9	28.3	46.0	37.1	53.8	50.8	52.3	51.4	52.4	51.9	41.0	30.4	35.7	40.0	40.4	40.2
5	53.4	47.6	50.5	35.6	35.1	35.4	50.0	27.7	38.8	49.5	41.7	45.6	55.6	26.0	40.8	49.3	40.0	44.7
6	42.4	49.8	46.1	32.6	43.6	38.1	61.8	51.0	56.4	55.9	50.5	53.2	39.3	79.5	59.4	46.3	54.5	50.4
7	51.0	16.1	33.5	41.7	21.4	31.5	55.6	68.4	62.0	49.3	56.8	52.5	55.6	49.5	52.5	49.3	49.5	49.4
8	12.8	32.5	22.7	14.3	33.5	23.9	79.8	51.0	65.4	55.4	50.5	53.0	67.2	54.2	60.7	51.4	47.4	49.4
9	100	13.0	56.5	53.0	16.0	34.5	54.2	42.9	48.6	47.4	50.9	49.1	65.0	90.2	77.6	47.0	62.1	54.5
10	66.6	52.3	59.5	42.9	31.9	37.4	56.4	42.9	49.6	52.2	48.8	50.5	54.2	32.2	38.2	47.4	41.2	44.3
11	40.5	82.2	61.3	26.0	46.4	36.2	34.6	31.4	33.0	43.6	37.4	40.5	70.4	33.3	51.9	55.8	40.3	48.1
12	75.1	100	87.6	41.7	44.0	42.9	55.8	39.3	47.6	46.2	44.3	45.3	35.2	25.5	30.3	37.1	34.5	35.8
13	58.8	61.6	60.2	35.5	41.2	38.3	48.7	39.3	44.0	44.7	44.3	44.5	25.6	24.5	30.1	34.6	36.5	35.5
14	56.8	42.3	49.5	37.6	40.3	39.0	52.5	39.3	45.9	43.5	44.3	43.9	38.5	23.3	30.9	39.5	35.7	37.6
15	66.0	93.8	79.9	42.0	49.2	45.6	62.0	31.9	47.0	50.0	44.9	47.4	23.3	24.3	23.8	35.7	40.3	38.0
16	81.0	93.8	87.4	42.5	49.2	45.8	53.6	17.7	35.6	51.3	26.3	38.8	18.3	42.9	30.6	36.0	48.8	42.4
17	51.4	46.8	49.1	40.8	43.8	42.3	53.6	28.8	41.2	52.3	41.5	46.9	49.2	30.9	41.4	48.8	42.3	45.6
18	49.1	40.3	44.7	42.7	42.3	42.5	37.6	23.3	30.5	41.6	35.7	38.7	60.4	42.3	51.3	38.3	40.3	39.3
19	......	......	......	......	......	......	37.8	30.2	34.0	45.4	43.2	44.3	44.2	37.4	40.8	42.1	43.4	42.8
20	......	......	......	......	......	......	37.4	36.5	36.9	43.4	46.5	44.9	63.2	48.4	55.8	43.1	46.7	44.9
21	26.6	30.4	28.5	36.2	40.4	38.3	46.6	24.5	35.6	49.6	36.5	43.1	78.5	42.3	60.4	49.5	40.3	44.9
22	100	74.5	87.3	48.0	52.5	50.3	38.8	37.5	38.1	45.4	43.5	44.4	69.4	54.2	61.8	48.8	47.4	48.1
23	87.6	64.0	75.8	47.2	46.0	46.6	48.4	29.3	38.9	46.7	38.7	42.7	72.8	53.2	63.0	48.6	44.6	46.6
24	87.6	75.0	81.3	47.2	53.5	50.3	42.2	31.2	36.7	44.1	38.6	41.4	44.2	31.6	32.9	41.1	40.3	40.7
25	70.4	29.8	50.1	50.8	36.8	43.8	43.6	27.9	35.7	46.3	36.9	41.6	44.2	34.8	39.5	42.1	47.5	44.8
26	75.0	33.3	54.1	53.5	40.3	46.9	48.7	41.4	45.1	47.7	45.2	46.4	51.4	67.6	59.5	40.8	54.8	47.8
27	53.2	42.2	47.7	45.6	44.1	44.9	73.1	78.8	75.9	47.7	51.4	49.6	28.3	81.5	54.9	31.3	44.5	37.9
28	48.7	31.2	39.9	44.7	42.2	43.4	78.5	60.3	69.4	50.5	46.1	48.3	100	75.1	87.6	42.0	41.7	41.8
29	47.4	37.4	42.4	48.7	43.4	46.1	100	95.2	97.6	57.0	63.1	60.0	49.7	68.0	58.8	35.9	45.0	40.5
30	52.0	41.1	46.6	47.5	48.1	47.8	61.0	48.6	54.8	49.0	45.8	47.4	42.6	33.2	37.9	38.3	37.2	37.7
31							37.8	18.4	28.1	42.4	34.9	38.7	38.5	23.3	30.9	39.5	30.3	34.9
Sums.	1655.7	1508.6	1544.3	1114.1	1153.9	1104.3	1674.1	1274.9	1474.5	1484.6	1369.9	1427.2	1565.1	1402.0	1483.5	1345.4	1361.4	1353.4
Means	61.3	54.2	53.5	41.3	41.2	40.9	54.0	41.1	47.6	47.9	44.2	46.0	50.5	45.2	47.8	43.4	43.9	43.7

Table VIII. **Per Cent of Saturation of Air and Temperature of Dew Point at Lander.**

Date.	SEPTEMBER.						OCTOBER.						NOVEMBER.					
	RELATIVE HUMIDITY			DEW POINT.			RELATIVE HUMIDITY			DEW POINT			RELATIVE HUMIDITY			DEW POINT		
	7 a.m.	6 p.m.	Mean.	7 a.m.	6 p.m.	Mean.	6 a.m.	6 p.m.	Mean	6 a.m.	6 p.m.	Mean.	6 a.m.	6 p.m.	Mean.	6 a.m.	6 p.m.	Mean.
1	89.4	29.3	59.3	55.2	38.7	46.9	71.1	43.1	57.1	42.7	37.4	40.0	76.0	82.5	79.2	27.8	27.5	27.6
2	77.8	51.0	64.4	46.6	46.5	46.6	56.4	48.0	52.2	31.7	40.0	35.9	82.5	83.0	82.8	27.5	30.4	29.0
3	64.2	48.6	56.4	38.1	45.7	41.9	42.4	40.2	41.3	27.8	37.6	32.7	90.8	79.4	85.1	27.3	35.6	31.4
4	76.4	65.0	70.7	42.8	48.0	45.4	41.1	30.3	35.7	30.7	28.3	29.5	72.0	57.7	64.8	32.0	34.5	33.3
5	32.0	31.5	31.8	28.0	36.5	32.2	38.2	37.6	37.9	30.1	37.8	33.9	100	42.4	71.2	34.0	23.2	28.6
6	42.6	37.6	40.1	38.3	37.8	38.1	47.6	53.6	50.6	35.1	45.6	40.4	72.0	46.3	59.2	23.8	12.0	17.9
7	58.7	37.0	47.8	35.5	35.0	35.2	20.7	68.4	44.5	7.7	46.8	27.2	16.0	82.5	49.2	−12.0	27.5	7.7
8	44.7	45.2	45.0	34.5	38.1	36.3	85.2	68.4	76.8	38.3	46.8	42.6	54.3	100	77.2	16.2	29.0	22.6
9	29.6	35.2	32.4	24.6	33.2	28.9	75.1	34.3	54.7	40.7	35.3	38.0	17.7	82.5	50.1	9.3	28.5	18.9
10	69.0	55.2	62.1	37.0	38.4	37.7	75.1	39.9	57.5	41.7	32.9	37.3	75.2	47.9	61.5	26.8	26.3	26.6
11	92.8	43.1	67.9	38.2	37.4	37.8	69.0	70.2	69.6	37.0	29.1	33.0	100	60.8	80.4	35.0	31.4	32.2
12	34.7	28.3	31.5	28.5	31.3	29.9	84.0	92.8	88.4	32.4	36.2	34.3	55.4	73.6	64.5	30.7	34.9	32.8
13	63.8	26.8	45.3	37.2	29.9	33.6	76.0	100	88.0	27.8	42.0	34.9	70.0	74.5	72.3	19.2	27.5	23.3
14	30.3	22.3	26.3	28.3	28.7	28.5	82.6	93.6	88.1	29.4	45.2	37.3	20.0	35.3	27.6	9.7	9.7	9.7
15	50.3	37.8	44.1	34.9	42.4	38.6	92.2	30.3	61.3	32.3	28.3	30.3	36.3	75.0	55.7	6.0	25.8	15.9
16	41.5	48.2	44.8	35.5	51.6	43.6	100	85.0	92.5	37.0	34.4	35.7	61.8	26.2	44.0	18.5	1.5	10.0
17	26.8	32.4	29.6	28.8	35.4	32.1	30.7	100	65.3	4.0	32.0	18.0	......	61.8	......	......	18.5	......
18	47.3	21.0	34.1	36.1	29.0	32.5	22.5	71.0	46.8	-2.5	30.0	13.8	38.4	71.0	54.7	9.3	30.0	19.7
19	49.9	22.0	35.9	35.9	29.0	32.5	100	92.0	96.0	29.0	34.2	31.6	20.0	28.2	24.1	9.7	19.2	14.4
20	34.7	47.6	41.2	28.5	35.1	31.8	82.5	63.7	73.1	27.5	28.3	27.9	100	53.5	76.7	33.0	15.2	24.1
21	73.6	28.3	50.9	35.9	31.3	33.6	100	85.6	92.8	30.0	36.4	32.2	55.5	76.0	65.8	17.8	27.8	22.8
22	30.0	27.2	28.6	26.5	31.6	29.0	82.6	92.8	87.7	29.4	42.2	35.8	100	41.3	70.6	35.0	25.2	30.1
23	36.2	24.0	30.1	23.8	30.0	26.9	68.6	67.0	67.8	25.3	34.0	29.6	83.0	32.7	57.9	30.4	26.7	28.6
24	45.2	32.5	38.9	38.1	33.5	35.8	63.7	55.0	59.3	28.3	29.0	28.7	68.7	53.5	61.1	37.9	15.2	26.5
25	60.0	38.5	53.7	37.0	39.5	38.3	63.6	72.6	68.1	27.3	33.9	30.6	64.2	......	......	1.5	......	......
26	50.3	38.5	44.4	34.9	39.5	37.2	58.0	45.6	51.8	26.7	26.7	26.7	......	50.2	......	......	10.7	......
27	55.1	42.3	48.7	38.4	39.3	38.8	41.4	53.4	47.4	22.2	35.6	28.9	......	100	......	......	22.0	......
28	63.8	45.0	54.4	37.2	45.0	41.1	43.2	67.1	55.2	24.8	33.1	28.9	93.2	67.0	80.1	28.3	34.0	31.2
29	64.4	53.2	58.8	45.2	44.6	44.9	84.0	68.7	76.3	32.4	37.9	35.2	73.6	41.3	57.4	35.9	25.2	30.5
30	82.2	43.6	62.9	46.4	46.3	46.4	73.6	79.4	76.5	35.9	36.6	36.2	53.0	40.5	46.8	27.0	26.0	26.5
31							92.8	74.4	83.6	36.2	37.8	37.0						
Sums.	1626.1	1138.2	1382.1	1075.9	1128.3	1102.1	2063.9	2024.0	2043.9	901.4	1111.4	1005.1	1749.6	1766.6	1620.0	609.6	701.0	622.9
Means	54.2	37.9	46.1	35.8	37.6	36.7	66.6	65.3	65.9	29.1	35.8	32.4	64.8	60.9	62.3	22.7	24.2	23.9

LANDER.

The meteorological records are reported by J. S, Meyer, Superintendent of the Experiment Farm. In addition to those given in the previous tables, the following phenomena are observed: Precipitation (See Table XIII.), direction and force of the wind, sunshine and character of the day. The latter indicates 13.6 per cent cloudy days, nearly 25 per cent clear, the remaining 61.4 per cent were partially cloudy, termed "fair." September was the sunniest month, having no cloudy days, while May was the cloudiest, having eleven cloudy days.

Only one storm of notable size was reported—that of July 7. At this time 1.91 inches of rain fell, 1.75 inches falling in about forty-five minutes. Such an amount falling in so short a time did considerable damage, washing out crops, carrying away bridges, etc. During the storm some hail fell near the base of the mountains, injuring three ranches. A small hail storm, doing no damage, occurred May 9th. The prevailing direction of the wind is southwest. High winds occurred in January, March, April and November. Warm west winds, chinooks, are reported for January and February as taking off the snow. Several thunder storms occurred in July and September. No damage from lightning is reported.

This section is protected by the surrounding mountains. The climate is moderate, seasons long enough to mature all crops grown under irrigation in regions of like latitude. Where the previous tables are incomplete the instruments were either broken or out of order.

SUMMARY.

Highest temperature, 92.0, August 1.

Warmest day (for 24 hours) August 15.

Lowest temperature, —26.0, January 11.

Coldest day (for 24 hours), January 11.

Mean temperature for the year, 44.8.

Greatest daily range of temperature, 57.0, December 22.

Lowest daily range of temperature, 3.0, June 3 and July 28.

Mean daily range of temperature for the year, 27.5.

Lowest relative humidity, 12.8, June 8.

Mean relative humidity (March, April and December omitted), 59.2.

Highest dew point, 62.1, August 9.

Lowest dew point, —12.0, November 7.

Mean dew point (March, April and December omitted), 31.4.

Greatest monthly precipitation, 4.89 inches, in April.

Lowest monthly precipitation, 0.0 inches in October. Traces in February and September.

Greatest precipitation during any single storm, 1.91 inches, July 7.

Total precipitation, 11.94 inches.

Frosts June 4 and 13. Light frost August 28. Killing frosts October 12 and 14.

Table IX.

TEMPERATURE AT SARATOGA, 1892.

Date.	JANUARY. 7 a.m.	2 p.m.	7 p.m.	Mean.	Max.	Min.	Daily R'nge
1	10	17	22	14.0	24	4	20
2	25	28	30	26.0	37	15	22
3	30	40	32	35.0	45	25	20
4	29	37	23	33.0	38	28	10
5	17	20	18	18.0	23	13	10
6	−2	28	21	13.5	30	−3	33
7	24	32	30	27.0	33	21	12
8	23	33	26	28.0	34	22	12
9	25	30	22	28.0	32	24	8
10	14	2	-10	7.5	26	−11	37
11	−20	8	6	7.0	11	**−25**	36
12	−5	9	0	14.5	18	11	7
13	−12	15	13	17.0	18	16	**2**
14	12	22	20	17.5	25	10	15
15	20	29	24	24.5	29	20	9
16	25	25	20	26.5	29	24	5
17	14	20	8	19.0	24	14	10
18	−1	20	19	9.5	20	−1	21
19	19	30	28	25.5	33	18	15
20	18	28	12	23.0	34	12	22
21	11	30	22	18.0	33	3	30
22	7	29	13	19.0	33	5	28
23	8	37	16	24.0	41	7	34
24	10	44	20	28.0	49	7	42
25	2	45	22	25.5	51	0	**51**
26	22	40	36	35.0	49	21	28
27	18	37	25	20.0	40	18	22
28	24	40	30	33.0	45	21	24
29	17	50	26	35.5	**55**	16	39
30	35	50	34	39.5	54	25	29
31	29	30	28	20.0	35	25	10
Sum..	448	895	636	716.5	1048	385	663
Mean.	14.4	28.8	20.5	23.1	33.8	12.4	21.4

Date.	FEBRUARY. 7 a.m.	2 p.m.	7 p.m.	Mean.	Max.	Min.	Daily R'nge
1	23	34	25	30.5	38	23	15
2	20	32	21	25.5	36	15	21
3	13	38	20	27.0	42	12	30
4	19	24	13	21.5	30	13	17
5	0	32	22	18.5	37	0	**37**
6	6	22	8	16.5	27	6	21
7	5	20	8	8.5	25	−8	33
8	9	20	0	7.5	25	**−10**	35
9	11	18	14	8.0	20	−4	24
10	20	26	26	23.5	32	15	17
11	25	34	27	31.5	38	25	**13**
12	20	40	29	31.0	43	19	24
13	22	32	29	31.5	42	21	21
14	19	24	21	21.0	29	13	16
15	20	30	22	24.5	37	12	25
16	19	38	28	29.5	42	17	25
17	29	38	30	34.5	43	26	17
18	26	36	27	33.0	40	26	14
19	29	38	30	36.0	44	28	16
20	29	38	32	36.5	45	28	17
21	30	46	32	38.5	**48**	29	19
22	30	44	31	37.5	46	29	17
23	23	26	12	23.5	35	12	23
24	13	35	15	24.0	36	12	24
25	7	38	24	23.5	40	7	33
26	23	40	28	33.0	44	22	22
27	24	22	21	32.5	42	23	19
28	24	40	32	31.0	44	18	26
29	30	45	27	37.5	**48**	27	21
30							
31							
Sum..	550	948	654	777.0	1098	456	642
Mean.	18.9	32.6	22.5	26.8	37.8	15.7	22.1

Date.	MARCH. 7 a.m.	2 p.m.	7 p.m.	Mean.	Max.	Min.	Daily R'nge
1	30	48	31	40.5	53	28	25
2	31	50	30	39.5	50	29	21
3	25	45	32	35.5	46	25	21
4	20	46	37	32.0	47	17	30
5	29	42	34	34.5	44	25	19
6	26	35	28	31.5	38	25	13
7	27	34	34	34.0	44	24	20
8	24	35	37	35.5	47	24	23
9	31	42	28	36.0	44	28	16
10	12	44	39	30.5	50	11	39
11	29	53	41	40.0	53	27	26
12	29	54	40	41.5	55	28	27
13	27	54	47	40.5	**56**	25	31
14	36	30	27	29.0	42	16	26
15	11	34	23	24.5	39	10	29
16	12	30	11	22.0	33	11	22
17	4	34	25	20.0	39	**1**	**38**
18	19	44	36	31.0	46	16	30
19	35	43	47	39.5	49	30	19
20	26	34	32	32.0	44	20	24
21	23	32	28	28.0	33	23	**10**
22	24	36	28	29.5	41	18	23
23	24	43	31	33.0	43	23	20
24	22	41	32	31.0	44	18	26
25	22	27	23	24.0	30	18	12
26	14	32	24	23.5	34	13	21
27	21	44	28	30.0	48	12	36
28	36	55	30	42.5	55	30	25
29	17	35	31	27.5	38	17	21
30	32	40	35	36.0	44	28	16
31	30	32	25	33.0	38	28	**10**
Sum..	748	1248	993	1007.5	1367	648	719
Mean.	24.1	40.2	32.0	32.5	44.1	20.9	23.2

Table LV.--Continued. **TEMPERATURE AT SARATOGA, 1892.**

Date.	APRIL.							MAY.							JUNE.						
	7 a.m.	2 p.m.	7 p.m.	Mean.	Max.	Min.	Daily R'nge	7 a.m.	2 p.m.	7 p.m.	Mean.	Max.	Min.	Daily R'nge	7 a.m.	2 p.m.	7 p.m.	Mean.	Max.	Min.	Daily R'nge
1	19	33	26	27.0	35	19	16	56	62	45	48.5	63	34	29	50	63	65	41.5	68	**15**	**53**
2	21	42	35	32.0	44	20	24	36	57	39	44.0	58	30	28	52	74	65	55.5	77	34	43
3	23	38	26	31.5	44	19	25	28	45	48	38.0	53	**23**	30	64	75	52	56.0	78	34	44
4	23	25	23	24.5	26	23	**3**	46	51	37	43.0	51	35	16	38	30	33	33.5	38	29	**9**
5	18	33	32	23.0	34	**12**	22	33	34	36	37.0	44	30	14	40	55	54	43.0	56	30	26
6	32	40	42	31.5	50	13	**37**	35	53	38	42.5	57	28	29	50	68	65	51.0	72	30	42
7	32	47	37	40.0	49	31	18	48	50	41	44.5	59	30	29	55	77	70	56.5	78	35	43
8	25	44	39	35.0	47	23	24	32	34	38	34.0	38	30	**8**	60	77	64	59.0	78	40	38
9	39	50	49	38.0	52	24	28	31	47	43	40.0	51	29	22	65	76	68	60.0	78	42	36
10	33	48	38	42.0	50	34	16	40	51	40	41.0	52	30	22	54	58	51	51.5	63	40	23
11	35	52	42	42.0	57	27	30	46	45	48	46.0	53	39	14	44	57	60	49.0	59	39	20
12	33	32	25	38.0	44	32	12	38	44	35	41.0	52	30	22	51	58	45	46.5	61	32	29
13	28	30	34	32.5	43	22	21	34	45	35	42.5	53	32	21	50	60	65	52.5	67	38	29
14	33	50	47	38.5	54	23	31	32	45	45	39.0	48	30	18	58	76	69	62.0	80	44	36
15	39	60	48	45.5	60	31	29	50	61	53	47.0	62	32	30	53	72	52	56.0	73	39	34
16	41	58	50	44.5	60	29	31	41	55	52	47.5	59	36	23	49	44	44	50.0	65	35	30
17	45	52	41	42.0	55	29	26	44	60	55	49.0	62	36	26	52	64	65	53.0	70	36	34
18	27	52	32	38.5	53	24	29	45	62	58	48.5	64	33	31	60	75	67	57.5	75	40	35
19	27	35	24	30.5	35	26	9	50	62	45	50.0	65	35	30	64	76	72	62.0	78	46	32
20	22	29	21	26.5	33	20	13	36	62	42	38.5	52	25	27	63	80	70	64.5	82	47	35
21	20	34	34	27.0	39	15	24	38	60	58	48.5	63	34	29	65	81	78	65.5	83	48	35
22	30	47	42	37.0	50	24	26	48	65	60	50.5	72	29	**43**	63	88	67	66.5	89	44	45
23	36	40	36	38.5	50	27	23	50	70	58	54.0	**74**	34	40	55	80	71	64.5	**90**	39	51
24	34	51	45	40.0	51	29	22	52	64	58	53.5	65	42	23	57	82	76	67.5	85	50	35
25	36	48	46	42.5	49	36	13	50	68	58	52.5	71	34	37	58	85	79	65.0	86	44	42
26	38	50	35	46.5	60	33	27	52	72	60	53.0	73	33	40	58	79	75	64.0	82	46	36
27	30	36	35	31.5	40	23	17	52	60	55	54.0	64	44	20	61	81	76	61.0	83	39	44
28	35	48	42	36.0	51	21	30	48	61	55	54.0	66	42	24	60	83	80	62.5	85	40	45
29	45	64	54	51.5	**68**	35	33	51	64	48	55.5	65	46	19	67	69	74	63.5	75	52	23
30	46	68	55	53.5	**68**	39	29	42	50	44	45.0	53	37	16	65	81	72	64.5	85	44	41
31								40	52	34	43.5	54	33	21							
Sum..	955	1354	1135	1107.0	1451	763	688	1324	1720	1463	1425.5	1816	1035	781	1681	2124	1944	1705.0	2239	1171	1068
Mean.	31.8	45.1	37.8	36.9	48.4	25.4	23.0	42.7	55.5	47.2	45.9	58.6	33.4	25.2	56.0	70.8	64.8	56.8	74.6	39.0	35.6

Table IX.--Continued. **TEMPERATURE AT SARATOGA, 1892.**

Date.	JULY.							AUGUST.							SEPTEMBER.						
	7 a.m.	12 m.	7 p.m.	Mean.	Max.	Min.	Daily R'nge	7 a.m.	12 m.	7 p.m.	Mean.	Max.	Min.	Daily R'nge	7 a.m.	12 m.	7 p.m.	Mean.	Max.	Min.	Daily R'nge
1	64	76	62	64.0	76	52	24	65	87	83	67.5	90	45	45	55	80	64	58.5	82	35	47
2	52	60	52	53.5	61	46	**15**	67	88	83	69.5	**92**	47	45	55	73	57	59.0	73	45	28
3	48	69	66	53.0	75	**31**	44	64	89	75	71.0	**92**	50	42	45	69	75	55.5	75	36	39
4	62	78	78	60.5	83	38	45	70	88	75	69.5	89	50	39	55	65	57	52.0	73	31	42
5	64	85	75	68.5	88	49	39	55	82	75	65.5	86	45	41	55	76	60	56.5	79	34	45
5	70	85	79	70.5	89	52	37	66	85	75	72.0	88	56	32	48	78	67	59.5	82	37	45
7	62	77	63	68.5	80	57	23	70	81	72	69.0	84	54	**30**	47	75	57	56.5	77	36	41
8	59	73	58	64.5	77	52	25	58	77	58	64.0	80	48	32	45	67	55	52.5	69	36	33
9	60	73	72	60.0	78	42	36	52	77	62	60.0	78	42	36	42	74	65	56.0	76	36	40
10	60	77	73	64.5	85	44	41	61	79	71	63.5	80	47	33	42	57	47	45.0	60	30	30
11	72	79	76	70.5	84	57	27	62	78	70	64.5	83	46	37	44	62	56	43.0	67	**19**	48
12	55	80	76	62.5	85	40	45	59	82	72	62.0	85	39	46	42	70	57	49.5	74	25	49
13	69	82	75	70.5	84	57	27	58	82	75	63.0	87	39	48	40	75	60	54.0	78	30	48
14	59	82	81	65.5	86	45	41	58	85	75	65.0	89	41	48	38	75	60	55.0	80	30	**50**
15	60	83	67	64.0	86	42	44	62	87	72	66.0	90	42	48	52	79	64	60.5	83	38	45
16	65	84	64	65.5	87	44	43	64	77	73	64.0	88	40	48	52	80	65	62.0	82	42	40
17	68	80	75	68.5	81	56	25	60	82	72	68.0	86	50	36	55	75	60	58.0	77	39	38
18	63	83	77	65.0	88	42	**46**	51	72	65	60.0	80	40	40	58	76	65	64.5	80	49	31
19	65	87	84	69.5	**91**	48	43	55	79	66	62.5	83	42	41	53	77	57	58.5	79	38	41
20	70	82	75	71.0	88	54	34	50	71	65	60.0	82	38	42	57	69	51	57.5	73	42	31
21	68	85	67	72.5	90	55	35	48	80	64	58.5	83	34	**49**	38	69	57	51.0	72	30	42
22	65	87	75	70.0	89	51	38	50	79	66	59.5	80	39	41	55	69	60	56.0	72	40	32
23	65	81	74	69.5	87	52	35	49	71	65	56.5	75	38	37	55	70	60	60.0	72	48	24
24	70	84	72	72.5	88	57	31	55	79	67	62.5	83	42	41	57	71	60	62.5	74	51	**23**
25	65	83	65	68.5	87	50	37	54	75	65	64.0	78	50	28	52	72	58	57.5	76	39	37
26	61	81	72	66.0	85	47	38	50	75	71	56.5	79	34	45	43	72	60	56.0	80	32	48
27	56	74	65	65.0	76	54	22	58	75	60	63.0	78	48	**30**	47	73	60	59.0	78	40	38
28	52	69	57	60.5	73	48	25	37	77	41	58.5	80	37	43	45	80	62	58.5	83	34	49
29	57	77	68	63.5	80	47	33	37	58	58	48.0	65	**31**	34	49	80	64	59.0	82	36	46
30	60	77	76	60.0	80	40	40	51	72	68	56.5	77	36	41	43	80	70	60.5	**84**	37	47
31	55	79	78	62.0	84	40	44	58	70	66	54.5	72	37	35							
Sum.	1921	2452	2197	2030.0	2571	1489	1082	1754	2439	2125	1944.5	2562	1327	1235	1464	2188	1810	1693.5	2292	1095	1197
Mean.	60.0	79.1	70.9	65.5	82.9	48 0	34.9	56.6	78.7	68.5	62.7	82.6	42.8	39.8	48.8	72.9	60.3	56.5	76.4	36 5	39.9

Table IX.--Concluded. **TEMPERATURE AT SARATOGA, 1892.**

Date.	OCTOBER. 7 a.m.	12 m.	7 p.m.	Mean.	Max.	Min.	Daily R'nge	NOVEMBER. 7 a.m.	12 m.	7 p.m.	Mean.	Max.	Min.	Daily R'nge	DECEMBER. 7a. m.	12 m.	7 p.m.	Mean.	Max.	Min.	Daily R'nge
1	57	77	54	63.0	**78**	48	30				Record lost.				44	38	38	46.0	**54**	38	16
2	35	64	48	47.0	66	28	38								28	44	32	36.0	44	28	16
3	30	61	55	47.0	72	22	**50**								20	48	43	34.5	50	19	31
4	33	69	55	49.0	74	24	**50**								35	49	34	40.5	50	31	19
5	35	69	52	48.0	72	24	48								26	31	25	29.0	33	25	8
6	36	70	50	51.5	74	29	45								18	21	13	19.0	30	8	22
7	41	65	54	52.5	71	34	37								8	20	5	18.0	31	5	25
8	32	66	50	46.0	68	24	44								9	19	12	6.0	20	-8	28
9	48	66	62	53.5	69	38	31								6	22	5	10.0	24	-4	28
10	43	51	40	48.0	56	40	16								17	24	12	10.0	25	-3	30
11	44	38	34	42.0	50	34	16								-4	27	4	11.5	28	-5	33
12	31	32	30	31.5	34	29	5								-3	30	7	12.5	31	-6	37
13	30	28	28	33.5	39	28	11								14	21	12	5.5	23	-12	35
14	32	40	32	32.5	44	21	23								-10	8	0	3.5	20	-13	33
15	34	52	40	43.0	57	29	28								9	17	13	8.5	20	-3	23
16	40	61	34	48.5	64	33	31								15	17	6	-3.5	19	**-26**	**45**
17	28	32	24	26.5	34	19	15	10	24	40	.....	.....	**6**	.....	-25	10	-7	-6.0	14	**-26**	40
18	26	35	25	31.0	39	23	16	33	44	42	34.5	45	24	21	-9	25	15	8.0	26	-10	36
19	21	40	32	29.5	45	14	31	41	51	36	39.0	53	25	28	-3	20	14	6.0	21	-9	30
20	29	41	38	30.0	47	**13**	34	37	44	31	34.5	46	23	23	-4	8	5	-5.0	9	19	28
21	38	50	35	32.0	51	**13**	38	33	13	33	33.0	44	22	22	-15	21	4	4.0	23	-15	38
22	40	56	36	35.0	56	14	42	24	48	31	36.0	51	21	30	23	31	31	21.5	38	5	33
23	40	50	30	32.0	51	**13**	38	36	53	38	42.0	54	30	24	33	30	31	36.0	43	29	14
24	40	50	42	33.5	54	**13**	41	43	52	30	41.5	**55**	28	27	38	47	38	38.0	47	29	18
25	21	47	28	31.5	49	14	35	14	22	21	21.5	30	13	17	31	43	25	31.5	45	18	27
26	18	50	37	34.5	55	14	41	26	30	20	25.5	34	17	17	25	34	34	27.5	38	17	21
27	31	59	38	40.5	60	21	39	14	37	34	26.0	42	10	32	20	33	25	18.0	35	1	34
28	20	58	35	43.5	65	22	43	35	44	41	40.0	47	33	**14**	6	20	30	20.5	35	6	29
29	43	65	40	50.5	69	32	37	35	50	43	41.0	52	30	22	25	21	34	18.5	38	-1	39
30	39	49	35	38.0	50	26	24	37	50	43	41.0	54	28	**34**	9	21	21	16.0	23	9	14
31	35	37	36	34.5	45	24	21								21	23	21	22.0	24	20	4
Sum ..	1069	1626	1238	1259.0	1758	760	998	418	592	483	455.5	607	310	311	428	841	582	543.5	961	126	835
Means	34.5	52.4	39.9	40.6	56.7	24.5	32.2	29.9	42.3	34.5	35.0	46.7	21.6	23.9	13.5	27.1	18.8	17.5	31.0	4.1	26.9

SARATOGA.

The records are reported by J. D. Parker, Superintendent of the Experiment Farm. Observations on the character of the day indicate 16.5 per cent cloudy days, with April the cloudiest month, 38.3 per cent clear days, with September the sunniest month. The remaining 45.2 per cent are "fair." The prevailing direction of the wind is southwest. High winds are reported in January and March. Thunder storms occurred in May, June and July. The nights are cool, which causes frequent light frosts in the early and late parts of the season. The deepest snow fell October 11 and 12.

Located in a broad valley, Saratoga is fairly well protected, and although over 6,700 feet in elevation, the climate is favorable to the production of stock, cereals and the more hardy farm and garden crops.

SUMMARY.

Highest temperature, 92, August 2 and 3.
Warmest day (for 24 hours), July 24.
Lowest temperature, —26, December 16 and 17.
Coldest day (for 24 hours), December 17.
Mean temperature for the year, 41.6.*
Greatest daily range of temperature, 53, June 1.
Least daily range of temperature, 2, January 13.
Mean daily range of temperature for the year, 29.0.
Greatest monthly precipitation, 2.65 inches, in May.

Least monthly precipitation, 0.0 in September. Trace in July.

Greatest precipitation during any single storm, 1.61 inches, on October 11 and 12.

Total precipitation, 8.91 inches. (See Table XIII.)

Frosts occurred June 1, 4, 5, 6. Light frosts July 3, August 29 and September 4. Killing frost September 11.

*Mean annual temperature from three daily readings is 43.5. Records for first 16 days in November being lost are not accounted for in any of the above.

Table V.

TEMPERATURE AT SHERIDAN, 1892.

Date.	JANUARY. 7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range
1	−7	14	13.5	40	−9	**49**
2	5	23	28.0	**51**	5	46
3	44	31	34.5	50	19	31
4	26	23	30.0	34	26	8
5	...	14	19.5	20	19	**1**
6	−14.5	0	4.2	23	−14.5	38
7	19	16	17.8	31	4.5	26
8	12	13	16.0	20	12	8
9	3	1	7.2	11.5	3	9
10	−7	−30	......	6	......	......
11	−43	−15	−22.5	1	**−46**	47
12	−20	−2	−2.5	18	−23	41
13	−21	10	−3.5	19	−26	45
14	−16	3	−3.5	9	−16	25
15	5	20	15.5	32	−1	33
16	23	......	22.5	25	20	5
17	−5	......	−0.5	4	−5	9
18	−8	4	7.0	27	−13	40
19	26	34	23.0	42	4	38
20	23.5	......	27.5	33	20	13
21	28.5	25	15.0	35	−5	40
22	4	15	22.0	41	3	38
23	10	20	22.5	42	3	39
24	1	21	19.7	43	−3.5	46
25	0	10	13.5	30	−3	33
26	6	23	19.5	42	−3	45
27	29	15	31.5	50.5	12.5	38
28	5	15	18.2	34	2.5	32
29	9.5	18	23.5	42	5	37
30	23	35	26.5	50	3	47
31	27	......	28.0	30	26	4
Sum.	188.5	358	477.5	936	19.5	910
Mean.	6.3	12.1	15.4	30.2	0.7	30.3

Date.	FEBRUARY. 7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.
1	15	11	21.7	33.5	10	23
2	5	......	19.0	35	3	32
3	2	0	9.0	30	−12	42
4	−12	2	6.0	25	**−13**	38
5	−4	5	14.3	36	−7.5	44
6	0	8	8.5	21	−4	25
7	10	19	21.0	32	10	22
8	−5	3	14.5	34	−7	43
9	0	......	12.0	26	2	28
10	26	......	26.0	28	24	4
11	25	......	29.5	34	25	9
12	16	47	27.5	47	8	39
13	17	......	23.5	30	17	13
14	13	14	20.0	29	11	18
15	−2	13	15.0	32	−2	34
16	−6	18	13.0	36	−10	**46**
17	7	......	17.0	27	7	20
18	8	2	7.0	25	−11	33
19	−8	13	8.0	28	−12	40
20	−4	12	11.7	30	−6.5	37
21	6	26	20.5	39	2	37
22	19.5	33	27.8	37	18.5	18
23	29	......	34.0	40	28	12
24	0	21	19.0	38	0	38
25	−2	20	18.0	38	−2	40
26	−9.5	35	20.2	41	−0.5	41
27	21	20	31.5	**43**	20	23
28	14	29	23.5	38	9	29
29	20	28	20.0	40	18	22
30						
31						
Sum.	195	379	547.7	974.5	121	853.5
Mean.	6.7	17.2	18.9	33.6	4.2	29.4

Date.	MARCH. 7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.
1	15	32	26.5	39	14	25
2	19	34	30.0	42	18	24
3	33.5	......	37.5	42	33	9
4	13	32	27.5	43	12	31
5	10	37	27.0	45	9	36
6	23	31	30.5	41	20	21
7	18.5	42	34.7	51	18.5	33
8	27	35	40.5	54	27	27
9	11	11	22.0	33	11	22
10	12	37	34.0	57	11	**46**
11	27	44	32.5	54	11	43
12	33	......	32.0	34	30	4
13	32	31	32.0	35	29	6
14	21	......	27.0	33	21	12
15	17	15	20.5	26	15	11
16	6	12	16.8	30	3.5	26
17	2	23	18.0	30	**−3**	42
18	25	27	26.0	36	16	20
19	21	27	25.0	34	16	18
20	17	......	24.5	33	16	17
21	21	27.5	19.5	37	2	35
22	35	31	33.5	45	22	23
23	26	42	36.0	49	23	26
24	31	37	39.5	53	26	27
25	30	35	30.0	35	25	10
26	34	34	36.0	43	29	14
27	23	46	32.0	47	17	30
28	30	43	45.0	**62**	28	34
29	34	42	41.0	50	32	18
30	30	40	41.2	57.5	25	32
31	34	......	32.5	34	31	**3**
Sum.	711	847.5	950.7	1313.5	588	725
Mean.	22.9	32.6	30.6	42.4	19.0	23.4

Table X.--Continued. **TEMPERATURE AT SHERIDAN, 1892.**

	APRIL.						MAY.						JUNE.					
Date.	7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.	7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.	7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.
1	27.5	......	34.5	42	27	15	37	38	37.5	42	33	9	52	68	58.0	78	38	40
2	28	38	33.5	49	18	31	30	30	31.5	33	30	3	48	57	57.0	67	47	20
3	30	32	32.5	40	25	15	30	40	35.0	42	28	14	39.5	40	41.5	45	38	7
4	32	......	32.5	34	31	3	31.5	32	32.0	34	30	4	38	47	42.0	48	36	12
5	25	35	31.5	43	20	23	30	35	32.0	36	28	8	48	51	45.5	57	34	23
6	37	43	38.0	47	29	18	30	38.5	32.5	40	25	15	40.5	63.5	52.5	70	35	35
7	31	......	32.0	35	29	6	37	33	30.5	46	33	13	60	77	63.0	86	40	46
8	14	33	21.0	37	5	32	35	41	39.0	46	32	14	60	65	66.5	83	50	33
9	28.5	37	32.5	43	22	21	38	45	45.2	55	35.5	20	56	65	61.7	75	48.5	27
10	35	42	38.5	48	29	19	39	45	43.0	48	38	10	55	61	60.0	67	53	14
11	32	46	43.0	57	29	28	40	42	40.5	43	38	5	57.5	53	51.8	61	42.5	18
12	31	31	32.5	34	31	3	36	43	39.5	47	32	15	52	53	52.0	54	50	4
13	26.5	48	37.2	53	21.5	32	33	48	40.3	49	31.5	17	49	57	53.0	61	45	16
14	31.5	56	44.5	64	25	39	38.5	53	44.0	61	27	34	52	63	57.0	77	37	40
15	40	63	53.3	74	32.5	41	45	60	53.0	71	35	36	53	62	56.0	65	47	18
16	45	47.5	48.2	55	41.5	14	50	51	50.0	53	47	6	53	61	56.5	66	47	19
17	39	39	38.3	44	32.5	11	58	57	54.0	68	40	28	60	72	60.5	77	44	33
18	37	34	35.5	39	32	7	48	60	50.0	63	37	26	61	68	65.5	82	49	33
19	31.5	33	32.2	34	30.5	4	47	47	47.5	49	46	3	66	71	62.5	77	48	29
20	32	33	32.0	34	30	4	42	51	43.7	56	31.5	25	61	60	60.0	70	50	20
21	26.5	40	33.0	45	21	24	52	67	56.0	72	40	32	56	67	58.7	71	46.5	25
22	35	47.5	39.0	54	24	30	53	60	58.5	84	33	51	50	45.5	50.0	52	48	4
23	40	53.5	41.5	55	28	27	57	63	58.0	74	42	32	46	55	51.3	59	43.5	15
24	37	53	43.3	55	31.5	23	51	63	55.3	65	45.5	19	50	60	......	......	45	......
25	41.5	45	44.5	55	34	21	49	63	54.5	64	45	19	56	66	......	......	50	......
26	33	34.5	30.0	35	25	10	55	72.5	59.0	76	42	34	55	69	......	......	48.5	......
27	31	33	31.0	37	25	12	59.5	54	61.0	72	50	22	57	77	......	......	47	......
28	30	45.5	37.5	55	20	35	55	55	57.0	65	49	16	56	80	......	......	45	......
29	36	57.5	45.0	64	26	38	......	46	47.0	50	44	6	52	76	......	......	45	......
30	43	38	43.0	49	37	12	43	42	49.5	59	40	19	57	76	......	......	46	......
31							44	56	47.0	63	31	32						
Sum .	986.5	1138	1111.0	1410	812	598	1293.5	1531	1432.5	1726	1139	587	1596.5	1886	1282.5	1548	1343.5	531
Mean.	32.8	40.7	37.0	47.0	27.0	20.0	43.1	49.4	46.2	55.7	36.7	19.0	53.2	62.8	55.7	55.3	44.8	23.0

Table X.--Continued. **TEMPERATURE AT SHERIDAN, 1892.**

JULY.

Date.	7 a. m.	7 p. m.	Mean.*	Max.	Min.	Daily Range.
1	68	51	59.5	No report.	46	No report.
2	52	58	55.0		50	
3	52	68	60.0		43	
4	60	75	67.5		45	
5	61	80	70.5		49	
6	63	86	74.5		44	
7	68	69	68.5		58	
8	62	73	67.5		56	
9	64	78	71.0		50	
10	67	84	75.5		49	
11	67	72	69.5		49	
12	65	81	73.0		47	
13	59	73	66.0		47	
14	51	72	61.5		50	
15	54	84	69.0		45	
16	68	84	76.0		46	
17	66	83	74.5		65	
18	64	81	72.5		53	
19	61	85	73.0		48	
20	70	81	75.5		62	
21	70	84	77.0		53	
22	70	87	78.5		55	
23	50	77	63.5		43	
24	65	76	70.5		**41**	
25	53	80	66.5		43	
26	52	79	65.5		45	
27	52.5	56	54.2		51	
28	57.5	68	62.8		51	
29	61	72	66.5		**41**	
30	62	75	68.5		47	
31	67	79	73.0		51	
Sum	1902	2351	2126.5	....	1523	....
Mean.	61.3	75.8	68.6	....	49.3	....

AUGUST.

Date.	7 a. m.	7 p. m.	Mean.*	Max.	Min.	Daily Range.
1	52	87	69.5	No report.	41.5	No report.
2	65	81	73.0		51	
3	65	87	76.0		55	
4	80	76	78.0		65	
5	60	80	70.0		53	
6	70	80	75.0		55	
7	73	59	66.0		62	
8	57	60	58.5		56.5	
9	52.5	71	61.7		45.5	
10	58	82.5	70.3		45	
11	64	84	74.0		48	
12	66	84	75.0		58	
13	68	83	75.5		47	
14	72	89	80.5		49	
15	73	80	76.5		52	
16	72	73	72.5		55	
17	66	......	......		65	
18	57	68	62.5		38	
19	53	67.5	60.2	80	39	41
20	54.5	64	59.3	70	48	22
21	65	60	62.5	71.5	50	21
22	53	63	58.0	65	45.5	20
23	53	73	63.0	80	42	38
24	60	79	69.5	**89**	40	**49**
25	59	55	57.0	76	43	33
26	47.5	63	55.2	82	37	45
27	50	48	49.0	65	42	23
28	49	52	50.5	56	45	**11**
29	47	59	53.0	73	**35**	38
30	48.5	65	56.8	84	38.5	46
31	48	61	54.5	**89**	42	47
Sum	1858	2134	1963.0	980.5	1488.5	434
Mean.	59.9	71.1	65.4	75.4	48.0	33.4

SEPTEMBER.

Date.	7 a. m.	7 p. m.	Mean.	Max.	Min.	Daily Range.
1	65	68	62.5	81	44	37
2	53.5	60	56.7	64	49.5	**15**
3	52	60	55.8	71	40.5	30
4	50	55	56.2	65.5	47	18
5	40	67	59.0	83	35	48
6	62	62	61.5	80.5	42.5	38
7	61	55	58.0	68	48	20
8	44.5	60	55.3	73	37.5	36
9	57	55	54.0	68	40	28
10	46	44	51.0	60	42	18
11	39	65	52.0	76	**28**	48
12	57	60	55.5	75	38	39
13				Records lost.		
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25		44	50.5	70	31	39
26	31	45	50.5	71	30	41
27	38	62	60.0	87	33	**54**
28	51	61	65.5	83	48	35
29	42.5	71	63.5	**92**	35	57
30	57	72	70.5	91	50	41
31	53	60	62.5	84	41	43
Sum	879.5	1126	1100.5	1443	758	685
Mean.	48.8	59.3	57.9	76.0	39.9	36.1

*From 7 a. m. and 7 p. m. readings.

Table X.--Concluded. **TEMPERATURE AT SHERIDAN, 1892.**

	OCTOBER.						NOVEMBER.						DECEMBER.					
Date.	7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.	7 a.m.	7 p.m.	Mean.	Max.	Min	Daily Range.	7 a.m.	7 p.m.	Mean.	Max.	Min.	Daily Range.
1	46	64	65.0	86	44	42	36	35	39.5	44	35	9	58	......	45.0	**59**	31	28
2	52	55	55.5	74	37	37	32	35	41.2	51	31.5	20	14	24	28.5	43	14	29
3	37	58	56.0	80	32	48	28	42	43.0	59	27	32	23	31	33.0	47	19	28
4	36	82	60.5	**88**	33	**55**	41	44.5	54.5	68	41	27	19	33	30.5	42	19	23
5	40	......	58.0	81	35	46	35	38	53.5	**74**	33	41	21	31	31.5	42	21	21
6	59	60	63.0	81	45	36	28	26	30.0	34	26	8	28	26	26.5	29	24	5
7	30	58	49.5	73.5	25.5	48	12.5	29	26.3	40	12.5	27	5	14	19.5	36	3	33
8	45	63	54.5	80	29	51	30	28	33.5	41.5	25.5	16	15	22	19.0	28	10	18
9	43	52.5	57.0	80	34	46	26	28	32.5	46	19	27	4	17	11.5	27	-4	31
10	53	54	57.5	69	46	23	29	48	41.7	62.5	21	41	20	......	23.5	32	15	17
11	47	......	47.5	51	44	**7**	26	40	42.0	59	25	34	5	4	14.0	33	-5	**38**
12	43	45	44.7	53.5	36	17.6	52	36	45.5	66	25	41	6	17	9.7	27	-7.5	34
13	25.5	41	39.5	54	25	29	36	..	40.5	46	35	11	15	18	15.0	28	2	26
14	39	46	45.5	63	28	35	24	30	41.5	59	24	35	3	17	15.0	33	-3	36
15	38.5	49	48.0	64	32	32	28	23	29.5	43	16	27	25	30	19.5	34	5	29
16	41	44	44.8	49	40.5	8	22	28	24.5	36	13	23	22	23	23.0	24	22	**2**
17	30	33	38.2	48	28.5	19	19	38	28.0	40	16	24	3	36	16.8	36.5	-3	40
18	32	35	39.5	51	28	23	41	......	40.0	46	34	12	37	23.5	27.0	37	17	20
19	37	41	41.5	48	35	13	25	58	43.0	61	25	36	12	12	15.5	23	8	15
20	28	34	40.3	57	23.5	34	25	25	28.0	36	20	16	16	-13	2.0	20	-16	36
21	34.5	37	40.5	57	24	33	18	23	32.0	46	18	28	12	-18	-6.7	4.5	-18	22
22	27.5	38	41.5	61	22	39	25	30	33.5	45	22	23	20	-5	-15.0	-4	**-26**	22
23	33	42	42.5	64	21	43	30	......	31.0	37	25	12	4	8	3.0	13.5	7.5	21
24	21.5	44	42.5	64	21	43	22	......	22.5	23	22	**1**	1	11	7.5	16	-1	17
25	33	37	41.2	57	25.5	31	6	......	12.0	20	4	16	8	8	11.5	15	8	7
26	26.5	34	46.3	67	25.5	42	-4	16.5	15.5	38	**-7**	45	7	24	10.0	25	5	30
27	33	42	51.5	75	28	47	3	20	18.5	37	0	37	35	31.5	31.0	38	24	14
28	32	45	41.7	52	31.5	20	20	54	33.0	57	9	**48**	18	24	27.0	37	17	20
29	25	39	39.8	58	21.5	37	31	35	42.3	54.5	30	25	21	28	23.5	29	18	11
30	24	40	37.7	54.5	21	33	25	34	40.0	56	24	32	15	15	15.0	24	6	18
31	22	40	35.5	53	**18**	35							37	23	29.8	43.5	10	34
Sum	1114	1352.5	1466.7	1993.5	940	1053	771.5	844	1038.5	1425.5	651.5	774	405	515	559.6	922	197	725
Mean.	35.9	46.3	47.3	64.3	30.3	34.0	25.7	33.8	34.6	47.5	21.7	35.8	13.1	17.8	18.0	29.8	6.5	23.4

SHERIDAN.

The observations are reported by J. A. Becker, Superintendent of the Experiment Farm. Observations on character of the day indicate 21 per cent cloudy days, with May the cloudiest month; 51.4 per cent clear days, with September the sunniest month, the remaining 27.6 per cent being "fair."

The prevailing direction of the wind is northwest. High winds were reported in March, April, May, June, July, August and November. Those in July are reported as hot and dry, but only of short duration, reaching their greatest velocity near noon or midnight. The largest storm was a heavy rain October 11. Sheridan is located at an altitude of about 4,000 feet. The cold in winter is sometimes severe, but the summers are warm, the growing season being comparatively long.

SUMMARY.

Highest temperature, 98(?).*

Warmest day (for 24 hours), August 14(?).

Lowest temperature, —46, January 11.

Coldest day (for 24 hours), January 11.

Mean temperature for year, 41.3.

Greatest daily range of temperature, 55, October 4.

Least daily range of temperature, 1, November 24.

Mean daily range of temperature for the year, 28.†

Greatest monthly precipitation, 3.29 inches, in June.

Least monthly precipitation, 0.12 inches, in September.

Greatest precipitation during any single storm, 1.56 inches, October 11.

Total precipitation, 16.26 inches. (See table XIII.)

Light frosts occurred May 13, 20 and 31. Killing frosts May 2 to 6 and September 11.

*Observed reading.

†Maximum temperature and daily range missing for July and parts of June, August and September.

Table XI. **TEMPERATURE AT SUNDANCE, 1892.**

JANUARY.

Date.	8 a. m.	8 p.m.	Mean.*	Max.	Min.	Daily Range.
1	10	8	9.0	23	2	21
2	15	28	21.5	32	5	27
3	25	28	26.5	39	23	16
4	22	......	....	27	20.5	7
5	15	......	....	18	10.5	7
6	6	9	7.5	18	−2	20
7	9	10.5	9.7	23.5	5	18
8	3	......	....	12.5	2	10
9	−3	−9	−6.0	6	No Record.	
10	−8	−22	−15.0	−4		
11	−18	10	−14.0	3		
12	−6	−8	−7.0	11		
13	−6	−3	−4.5	13		
14	−4	12	4.0	15		
15	12	14	13.0	28		
16	20	−3	8.5	27		
17	−18	−22	−20.0	0		
18	−26	4	−11.0	8		
19	20	32	26.0	39		
20	17	17	17.0	30		
21	18	16	17.0	35		
22	20	32	26.0	32		
23	22	23	22.5	42		
24	30	28	29.0	50		
25	27	26	26.5	47		
26	33	32	32.5	42		
27	28	22	25.0	43		
28	22	24	23.0	36.5		
29	21	26	23.5	45	21	24
30	39	32	35.5	50	26	24
31	24	......	....	26	23	3
Sum..	369	346.5	325.7	817.5	136	177
Mean.	11.9	12.8	12.1	26.3	12.3	16.1

FEBRUARY.

Date.	8 a. m.	8 p.m.	Mean.	Max.	Min.	Daily Range.
1	10	13	18.5	27	10	17
2	15	......	20.0	27	13	14
3	16	10	18.7	33	4.5	29
4	3	11	15.8	29	2.5	26
5	25	......	24.2	34	14.5	20
6	8	2	7.0	13	1	12
7	4	9	8.5	23	−6	29
8	13	......	17.5	26	9	17
9	11	22	15.8	26.5	5	22
10	18	21	21.0	26	16	10
11	20.5	26	25.0	29.5	20.5	9
12	30	29	29.7	42	17.5	25
13	14	......	15.5	18	13	5
14	8	2	8.0	14	2	12
15	13.5	9.5	15.0	28	2	26
16	25	22	24.5	39	10	29
17	9	12.5	16.8	25	8.5	16
18	2	5	13.2	25.5	1	24
19	22	32	19.5	37	2	35
20	28	33.5	28.5	44	13	31
21	32	32	37.0	50	24	26
22	36	33	37.5	43	32	11
23	29	25.5	29.0	39	19	20
24	25	23.5	28.8	39	18.5	20
25	29	27	33.7	46	21.5	25
26	33	31	34.3	44	24.5	19
27	20	22.5	25.0	30	20	10
28	18	18	26.5	40	13	27
29	32	28	28.5	41	16	25
30						
31						
Sum..	549.5	500.5	643.0	938.5	347.5	591
Mean.	18.9	20.0	22.1	32.3	11.9	20.4

MARCH.

Date.	8 a. m.	8 p.m.	Mean.	Max.	Min.	Daily Range.
1	32	28	35.0	49	21	28
2	37	37	38.0	50	26	24
3	31	32	34.2	38	30.5	8
4	30	30	36.0	43	29	14
5	35	35	36.0	49	23	26
6	35	30	39.3	49	29.5	19
7	40	37	38.5	49	28	21
8	37	......	39.2	48	30.5	17
9	10	11	15.3	20.5	10	11
10	20	32	26.0	45	7	38
11	38	37	44.5	61	28	33
12	49	......	46.7	61	32.5	29
13	15	16	19.8	25	14.5	10
14	14	......	17.5	21	14	7
15	4	−2	7.0	16	−2	18
16	0	−4	4.2	16	−7.5	23
17	5	15	10.0	25	−5	30
18	24	15	24.0	39	9	30
19	5	10	9.3	16	2.5	14
20	11	12	15.5	24	7	17
21	18	......	20.5	29	12	17
22	17	30	22.0	41	3	38
23	33	33	35.5	47	24	23
24	37	34	41.0	58	24	34
25	30.5	27	34.5	48	21	27
26	25	27	30.0	36	24	12
27	28	42	30.0	46	14	32
28	44	42	49.0	61	37	24
29	32	34	39.0	46	32	14
30	41	42	41.5	55	28	27
31	43	......	43.5	55	32	23
Sum..	820.5	682	922.5	1267.5	578.5	688
Mean.	26.4	26.2	29.8	40.9	18.6	22.3

*From 8 a. m. and 8 p. m. readings.

Table XI.--Continued. **TEMPERATURE AT SUNDANCE, 1892.**

	APRIL.						MAY.						JUNE.					
Date.	8 a.m.	8 p.m.	Mean.	Max.	Min.	Daily Range.	8 a.m.	8 p.m.	Mean.	Max.	Min.	Daily Range.	8 a.m.	8 p.m.	Mean.	Max.	Min.	Daily Range.
1	34.5	24	26.5	29	24	5	29.5	32	36.7	44	20.5	15	53	63	58.7	70.5	47	23
2	30	38	30.0	46	14	32	20	..	29.0	30	28	**2**	65	58	61.8	73	50.5	23
3	43	28	37.5	47	28	19	32	31	32.0	39	25	14	45.5	......	47.2	50	44.5	6
4	24	26	29.0	36	22	14	25	27	31.5	39	24	15	36	......	41.3	47	35.5	11
5	31	31	32.0	43	21	22	32	20	33.5	44	23	21	43	43	40.5	47	**34**	13
6	37	32	40.0	51	29	22	33	29	31.0	41	**21**	20	50	50	51.5	60	43	17
7	31	......	40.0	51.5	28.5	23	30	31	31.5	36	27	9	65	65	59.0	75	43	32
8	24	26	32.2	52	**12.5**	**40**	31	31	30.5	34	27	7	74	66	72.5	**83**	62	21
9	37	33	36.0	51	21	30	31	31	31.0	35	27	8	48	55	62.7	77.5	48	29
10	37	33	42.3	52	32.5	19	33	34	33.5	38	29	9	55	52	58.5	60	48	21
11	41	42	40.5	54	27	27	35	36	35.5	40	31	9	52	50	55.5	67	44	23
12	30	.....	34.2	40	28.5	12	39	37	40.0	49	31	18	46	46	50.5	60	41	19
13	27	32	35.0	46	24	22	37	36	37.0	42	32	10	48	48	51.0	59	43	16
14	42	48	41.0	55	27	28	40	38	45.5	59	32	27	60	60	58.5	78	39	**39**
15	48	47	52.0	**68**	36	32	40	48	50.0	63	37	26	60	54	59.0	66	52	14
16	48	42	49.5	60	39	21	55	52	53.5	65	42	23	50	49	51.5	57	46	11
17	43	38	44.5	53	36	17	53	50	53.5	59	48	11	56	55	59.0	74	44	30
18	36	.....	37.5	40	35	5	49	40	47.0	54	40	14	70	60	66.0	81	51	30
19	29	27.5	32.3	37	27.5	9	48	37	43.3	49.5	37	13	63	61	61.8	74	49.5	25
20	27	27	29.0	31	27	**4**	39	35	39.5	46	33	13	61	61	61.5	70	53	17
21	30	31	34.5	44	25	19	43	44	49.5	66	33	33	60	56	64.0	74	54	20
22	37	32	39.0	52	26	26	61	59	59.7	**78.5**	41	**37**	45.5	47	47.0	49	45	**4**
23	49	43	44.2	58.5	30	29	67	57	57.0	67	47	20	47	46	50.2	56	44.5	12
24	39.5	40	43.5	53	34	19	54	53	55.5	66	45	21	44	41	49.5	58	41	17
25	46	44	45.5	57	34	23	55	......	48.5	55	42	13	57	52	57.5	71	44	27
26	42	33	44.0	57	31	26	57	57	55.0	72	38	34	58	53.5	57.5	73	42	31
27	26	27	31.5	39	24	15	58	49	55.5	72	39	33	59	59	63.5	78	49	29
28	30	36	35.0	50	20	30	50	48	50.3	62	38.5	23	66	61	62.5	81	44	37
29	34	38	42.5	58	27	31	50	41	48.5	58	39	19	62	56	59.0	70	48	22
30	34	32	41.0	54	28	26	42	38	44.0	51	37	14	65	64	64.0	81	47	34
31							43	46	48.5	59	38	21						
Sum	1057	930.5	1141.7	1465	818.5	647	1320.5	1176	1337.0	1613	1061	552	1663	1540.5	1702.7	2029	1376.5	653
Mean.	35.2	34.5	38.0	48.8	27.3	21.5	42.6	40.5	43.1	52.0	34.2	17.8	55.4	55.0	56.7	67.6	45.9	21.7

Table XI.--Continued. **TEMPERATURE AT SUNDANCE, 1892.**

	JULY.						AUGUST.						SEPTEMBER.					
Date.	8 a. m.	8 p. m.	Mean.	Max.	Min.	Daily Range.	8 a. m.	8 p. m.	Mean.	Max.	Min.	Daily Range.	8 a. m.	8 p. m.	Mean.	Max.	Min.	Daily Range.
1	70	60	69.7	85	54.5	31	76	66	75.5	97	54	**43**	73	65	70.5	**89**	52	37
2	52	51	53.0	60	46	14	80	65	74.5	91	58	33	55	54	59.0	67	51	16
3	60	62	58.0	73	**43**	30	78	65	75.7	89.5	62	27	54	54	58.0	71	45	26
4	68	63	65.8	82	49.5	32	79	76	76.0	94.5	57.5	37	52	42	51.5	61	42	19
5	76	75	71.2	87.5	55	32	77	70	72.3	87	57.5	30	53	53	57.2	76	38.5	38
6	78	77	74.0	89	59	30	75	70	75.5	91	60	31	67	60	66.0	81	51	30
7	74	68	69.7	75	64.5	11	76	68	72.0	88	56	32	57	46	51.5	60	43	17
8	58	62	61.5	78	45	33	55	54	62.2	71	53.5	17	52	46	52.5	66	39	27
9	70	70	67.8	82	53.5	28	61	55	64.0	76	52	24	55	47	53.0	64	42	22
10	70	65	68.2	87	49.5	38	70	58	67.0	84.5	49.5	35	40	43	44.8	51	38.5	12
11	78	66	74.5	90	59	31	76	70	74.5	92	57	35	45	49	49.7	68	**31.5**	37
12	66	67	61.8	78.5	45	33	76	72	77.8	92	63.5	28	56	44	50.0	67	39	28
13	75	69	72.5	85	59	27	74	68	72.7	90	55.5	35	56	50	53.0	75	37	38
14	64	62	72.2	86	58.5	27	75	70	75.5	95	56	39	65	52	59.0	76	42	34
15	65	65	62.3	79.5	45	35	78	65	76.8	**98**	55.5	42	60	52	61.5	79	44	35
16	67.5	71	70.0	85	55	30	73	65	74.2	87	61.5	26	65	54	67.5	85	50	35
17	70	69	74.2	84	64.5	20	68	66	69.5	81	58	23	71	57	70.5	88	53	35
18	69	71	68.8	80.5	57	23	53	54	61.5	74	49	25	60	59	61.8	74.5	49	25
19	79	68	76.7	**95**	58.5	36	67	65	66.5	82	51	31	68	60	66.5	83	50	33
20	79	68.5	77.0	90	64	26	52	55	55.0	65	45	20	69	65	68.0	83	53	30
21	75	70	75.3	91	59.5	32	51.5	52	55.5	64.5	46.5	18	58	60	59.7	74.5	45	30
22	78	73	77.5	91.5	63.5	28	57	51.5	58.8	71.5	46	26	63	66	61.0	75	47	28
23	64	60	68.0	83	53	30	60	53	56.7	71	42.5	28	66	62	64.0	74	54	20
24	73	67	71.0	86	56	30	64.5	67	62.5	78	47	31	50	49	50.0	52	48	**4**
25	70	60	69.5	89	50	**39**	62	58	65.0	71	59	12	51	43	53.0	73	33	40
26	72.5	73	72.0	89	55	34	63	54.5	60.5	79	42	37	67	59	63.3	86.5	40	**46**
27	52	51.5	53.2	55	51.5	**3**	60	52	61.0	79	43	36	66	55	68.5	83	54	29
28	54	50	58.5	68	49	19	46	46	46.5	51	42	**9**	71	74	69.0	85	53	32
29	63	68	64.8	81	48.5	33	49	46	51.5	62	**41**	21	70	62	69.5	87	52	35
30	72	61	69.0	84	54	30	60	59	61.0	79	43	36	70	55	70.0	87	53	34
31	71	67	67.0	82	52	30	64	55	65.5	84	47	37						
Sum.	2133	2048	2114.8	2552.5	1677.0	875	2056	1891	2063.2	2515.5	1611	904	1845	1634	1805.5	2241.5	1369.5	872
Mean.	68.8	66.1	68.2	82.5	54.1	28.3	66.3	61.0	66.5	81.1	51.9	29.2	61.5	54.5	60.2	74.7	45.6	29.1

Table XI.—Concluded. **TEMPERATURE AT SUNDANCE, 1892.**

	OCTOBER.						NOVEMBER.						DECEMBER.					
Date.	8 a.m.	8 p.m.	Mean.	Max.	Min.	Daily Range.	8 a.m.	8 p.m.	Mean.	Max.	Min	Daily Range.	8 a.m.	8 p.m.	Mean.	Max.	Min.	Daily Range.
1	70	68	69.0	**83**	55	28	27	31	52.0	43	21	22	44	27	40.5	54	27	27
2	54	60	61.5	81	42	**39**	35	33	38.2	46	30.5	16	29	32	32.2	40	24.5	16
3	59	49	60.5	80	41	**39**	34	43	39.5	55	24	31	35	40	41.5	53	30	23
4	65	51	60.5	78	43	35	41	46	46.0	60	32	28	34	33	41.0	52	30	22
5	60	43	53.0	64	42	22	46	51	52.0	**66**	38	28	27	26	30.3	34.5	26	9
6	55	43	49.0	65	33	32	23	.....	23.0	26	20	**6**	25	.....	27.0	32	22	10
7	52	54	55.0	70	40	30	18	27	22.3	32	12.5	19	20	21	21.5	27	16	11
8	54	58	56.0	72	40	32	27	23	24.7	33.5	16	17	20	13	19.0	25	13	12
9	51	63	62.2	77	47.5	30	21	39	30.0	40	20	20	12	14	18.5	25	12	13
10	54	60	59.8	76	43.5	32	39	34	38.0	52	24	28	15	12	16.5	24	9	15
11	54	49	50.5	59	42	17	38	37	39.5	52	27	25	13	7	16.2	29	3.5	25
12	38	43	41.2	45	37.5	6	41	38	41.0	55	27	28	16	13	15.0	25	5	20
13	40	38	41.5	45	38	**7**	31	22	27.5	34	21	13	17	15	18.5	27	10	17
14	44	45	48.8	62	35.5	26	36	20	35.0	51	19	**32**	5	2	10.0	22	-2	24
15	59	44	55.0	74	38	36	27	26	26.0	38	14	24	15	16	14.8	28	1.5	27
16	55	44	52.0	67	37	30	28	24	23.5	32	15	17	19	......	18.5	23	14	9
17	32	30	33.0	42	**24**	18	19	29	24.5	33	16	17	11	17	15.7	27	4.5	22
18	32	27	33.5	42	25	17	30	27	27.0	36	18	18	21	19	21.3	30	12.5	18
19	37	29	35.5	47	**24**	23	29	43	31.5	44	19	25	8	......	6.5	11	2	9
20	39	40	38.5	53	**24**	29	18	15	20.5	28.5	12.5	16	-3	-8	-2.5	3	-8	11
21	47	37	42.0	54	30	24	32	35	29.5	45	14	31	-9	-12	-7.0	0	-14	14
22	40	39	43.5	60	27	33	35	39	33.0	45	21	24	-3	19	-1.5	20	**-23**	**43**
23	41	40	44.0	61	27	34	40	35.5	36.0	49	23	26	29	10	23.0	30	16	14
24	41	32	43.0	59	27	32	43	..	37.8	44	31.5	12	30	7	21.7	40	3.5	36
25	43	30	38.5	52.5	24.5	28	0	0	4.2	10	**-1.5**	11	-3	5	1.0	6	-4	10
26	40	39	44.0	60	28	32	20	20	15.3	31	-0.5	**32**	18	31	16.0	33	-1	34
27	50	40	50.2	68	32.5	36	23	25	22.5	35	10	25	32	23	31.5	35	38	**7**
28	35	27	30.8	48	31.5	16	30	35	32.0	46	18	28	21	21	24.5	31	28	13
29	41	30	36.7	48.5	25	23	39	44	44.2	55	33.5	22	19	18	23.3	31	15.5	16
30	35	35	35.5	43	28	15	41	43	46.0	55	37	18	11	16	20.0	30	10	20
31	38	27	36.0	47	25	22							25	21	24.5	36	13	23
Sum.	1460	1314	1470.2	1883	1057.5	825	916	893.5	942.2	1272	612.5	659	547	458	599.0	883.5	314.5	509
Mean.	47.0	42.4	47.4	60.7	34.1	26.6	30.5	31.9	31.4	42.4	20.4	22.0	17.7	16.3	19.3	28.5	10.1	18.4

SUNDANCE.

The observations are reported by Thomas A. Dunn, Superintendent of the Experiment Farm. The minimum thermometer was broken at the time of the coldest weather in January, so the lowest temperature cannot be given. The lowest observed temperature was —26, January 18. Observations on the character of the day indicate 20 per cent cloudy days, with May the cloudiest month; 49 per cent clear days, with September the sunniest month, the remaining 31 per cent being "fair." Severe storms from the northeast were reported April 3 and 4 and May 2, 3 and 4, injuring stock on the range. Hail storms occurred in April, May and June, doing slight damage. Except in connection wlth the above storms no high winds have been reported.

Sundance is located at an altitude of about 4,500 feet. The climate is mild and season of growth long. All crops are matured without irrigation.

SUMMARY.

Highest temperature, 98, August 15.

Warmest day (for 24 hours), August 12.

Lowest temperature, ————————.

Coldest day (for 24 hours), January 10.

Mean temperature for year, 41.2.

Greatest daily range of temperature, 46, September 26.

Least daily range of temperature, 2, May 2.

Mean daily range of temperature for the year, 22.8.

Greatest monthly precipitation, 4.58 inches, in April.

Least monthly precipitation, 0.46 inches, in February and September.

Greatest precipitation during any single storm, 1.3 inches, January 31.

Total precipitation, 24.69 inches. (See Table XIII.)

Light frost June 5. Killing frost September 11.

Table XII.

TEMPERATURE AT WHEATLAND, 1892.

Date.	JANUARY.				FEBRUARY.				MARCH.				APRIL.			
	Mean.	Max.	Min.	Daily R'nge.	Mean.	Max.	Min.	Daily Range.	Mean.	Max.	Min.	Daily Range.	Mean.	Max.	Min.	Daily Range.
1	24.5	35	14	21	24.5	34	15	19	42.0	60	24	36	41.0	54	28	26
2	26.0	40	12	28	26.0	40	12	28	42.0	50	25	34	41.0	55	27	28
3	45.5	50	41	9	35.0	45	25	20	36.0	40	32	8	38.5	48	29	19
4	32.0	45	19	26	30.5	40	21	19	39.0	45	33	12	31.0	40	22	18
5	27.5	45	10	35	22.5	34	11	23	41.0	47	34	12	37.0	49	25	24
5	16.0	30	2	28	23.5	35	12	23	36.0	42	30	12	45.0	50	40	10
7	27.5	35	20	15	24.0	38	10	28	37.0	45	29	16	41.5	52	31	21
8	21.5	30	13	17	17.5	30	5	25	39.0	49	29	20	47.0	55	39	16
9	6.0	12	0	12	27.0	34	20	14	25.0	30	20	10	45.5	59	34	25
10	−3.0	−2	−4	2	30.5	36	25	11	31.0	50	12	38	45.0	60	30	30
11	−8.5	4	−21	25	21.0	22	20	2	49.5	64	35	29	44.5	59	30	29
12	−0.5	10	−11	21	31.0	41	21	20	56.5	68	45	23	32.0	34	30	4
13	7.5	25	−10	35	39.5	43	36	7	38.5	48	29	19	38.5	55	22	33
14	14.5	29	0	29	30.5	39	22	17	22.5	24	20	4	45.5	60	31	29
15	25.0	30	20	10	32.0	49	15	34	15.0	20	10	10	52.5	65	40	25
16	30.5	31	30	1	38.5	54	23	31	12.0	24	0	24	41.0	42	40	2
17	2.5	10	−5	15	41.5	59	24	35	16.5	45	−12	57	53.0	65	41	24
18	−12.0	−4	−20	16	38.0	54	22	32	25.0	50	0	50	46.0	54	39	15
19	17.0	37	−3	40	41.5	53	30	23	27.5	40	15	25	29.0	30	28	2
20	31.0	38	24	14	50.0	60	40	20	30.5	45	16	29	34.5	40	29	11
21	27.0	34	20	14	50.5	60	41	19	22.0	29	15	14	37.5	50	25	25
22	27.0	39	15	24	47.5	61	34	27	36.5	58	15	43	38.0	55	21	34
23	34.0	48	20	28	38.0	45	31	14	40.0	60	20	40	46.5	60	33	27
24	43.0	56	30	26	39.0	55	23	32	45.5	61	30	31	48.0	62	34	28
25	35.0	50	20	30	42.0	60	24	36	40.0	49	31	18	52.5	65	40	25
26	35.0	55	15	40	42.0	61	23	38	42.0	58	26	32	47.0	60	34	26
27	41.5	55	28	27	37.5	45	30	15	45.5	64	27	37	43.0	45	41	4
28	40.0	50	30	20	37.0	54	20	34	45.0	63	27	36	56.5	68	45	23
29	41.0	51	31	20	34.0	53	15	38	47.0	64	30	34	60.0	72	48	24
30	48.5	58	39	19					46.0	61	31	30	62.5	78	47	31
31	25.0	30	20	10					45.0	54	36	18				
Sum.	727.5	1056	399	657	992.0	1334	650	684	1115.5	1516	715	801	1322.0	1641	1003	638
Mean.	23.5	34.1	12.9	21.2	34.2	46.0	22.4	23.6	35.9	48.9	23.0	25.8	44.1	54.7	33.4	21.3

Table XII.--Continued. TEMPERATURE AT WHEATLAND, 1892.

Date.	MAY.				JUNE.				JULY.				AUGUST.			
	Mean.	Max.	Min.	Daily Range.	Mean.	Max.	Min.	Daily Range.	Mean.	Max.	Min.	Daily Range.	Mean.	Max.	Min.	Daily Range.
1	47.0	54	40	14	59.5	79	40	39	70.0	80	60	20	84.0	100	68	32
2	44.5	50	39	11	67.0	83	51	32	65.0	75	55	20	77.0	98	56	42
3	44.0	58	30	28	62.0	74	50	24	59.5	74	45	29	76.5	98	55	43
4	36.5	40	33	7	38.0	43	33	10	69.0	89	49	40	82.5	105	60	45
5	39.0	48	30	18	45.0	50	40	10	71.0	92	50	42	81.5	102	61	41
6	44.5	58	31	27	57.0	79	35	44	73.5	95	52	43	81.0	100	62	38
7	37.5	45	30	15	68.5	89	48	41	61.5	72	51	21	78.0	96	60	36
8	39.0	48	30	18	67.5	84	51	33	60.0	70	50	20	71.5	89	54	35
9	44.0	59	29	30	60.0	70	50	20	70.0	88	52	36	67.5	84	51	33
10	49.5	65	34	31	63.0	78	48	30	69.0	87	51	36	74.0	90	58	32
11	42.5	50	35	15	55.0	65	45	20	71.5	90	53	37	75.5	89	62	27
12	37.0	41	33	8	57.5	75	40	35	70.5	88	53	35	77.0	94	60	34
13	41.5	50	33	17	59.5	78	41	37	75.5	95	56	39	78.5	98	59	39
14	56.5	68	45	23	63.5	80	47	33	71.0	90	52	38	79.0	98	60	38
15	53.0	59	47	12	54.5	65	44	21	69.0	85	53	32	87.0	102	72	30
16	59.0	70	48	22	54.0	65	43	22	74.0	92	56	36	82.0	100	64	36
17	60.0	70	50	20	62.5	80	45	35	73.5	91	56	35	68.5	84	53	31
18	59.5	71	48	23	66.5	81	52	29	76.0	94	58	36	63.5	75	52	23
19	47.5	55	40	15	67.0	82	52	30	76.0	95	57	38	62.0	74	50	24
20	45.0	54	36	18	71.5	87	56	31	74.5	90	59	31	63.0	75	51	24
21	57.0	70	44	26	67.0	84	50	34	88.5	109	68	41	62.0	74	50	24
22	64.5	80	49	31	63.5	70	57	13	86.0	105	67	38	61.0	74	48	26
23	60.5	76	45	31	60.5	70	51	19	80.0	100	60	40	64.0	78	50	28
24	67.0	84	50	34	58.0	68	48	20	78.5	99	58	41	72.5	86	59	27
25	61.5	78	45	33	59.5	70	49	21	75.5	97	54	43	74.0	89	59	30
26	61.0	79	43	36	70.0	85	55	30	70.5	91	50	41	74.0	88	60	28
27	60.0	78	42	36	71.5	89	54	35	53.0	61	45	16	67.0	80	54	26
28	65.0	80	50	30	73.0	90	56	34	59.5	70	49	21	54.0	70	38	32
29	60.0	74	46	28	72.0	90	54	36	66.0	84	48	36	66.5	83	50	33
30	41.5	43	40	3	70.5	90	51	39	65.0	83	47	36	71.0	84	58	26
31	51.5	64	39	25					60.0	89	49	40	58.0	70	46	24
Sum.	1576.5	1919	1234	685	1864.5	2293	1436	857	2191.5	2720	1663	1057	2233.5	2727	1740	987
Means	50.8	61.9	39.8	22.1	62.1	76.4	47.9	28.5	70.7	87.7	53.6	34.1	72.0	87.9	56.1	31.8

Table XII.—Concluded. **TEMPERATURE AT WHEATLAND, 1892.**

Date.	SEPTEMBER. Mean.	Max.	Min.	Daily Range.	OCTOBER. Mean.	Max.	Min.	Daily Range.	NOVEMBER. Mean.	Max.	Min.	Daily Range.	DECEMBER. Mean.	Max.	Min.	Daily Range.
1	62.0	75	49	26	73.0	92	54	38	49.5	70	29	41	50.5	71	30	41
2	64.0	78	50	28	68.5	89	48	41	47.5	71	24	47	49.5	69	30	39
3	65.0	80	50	30	63.5	87	40	47	42.5	60	25	35	54.5	74	35	39
4	66.5	82	51	31	64.0	89	39	50	47.5	64	31	33	64.5	80	49	31
5	67.0	84	50	34	65.0	88	42	46	51.5	70	33	37	49.0	70	28	42
6	68.0	85	51	34	63.5	80	47	33	50.0	70	30	40	40.0	60	20	40
7	69.0	85	53	32	68.0	90	46	44	44.5	65	24	41	36.0	54	18	36
8	70.0	88	52	36	66.0	87	45	42	37.0	54	20	34	36.5	53	20	33
9	64.5	80	49	31	67.5	88	47	41	41.0	59	23	36	22.5	30	15	15
10	57.5	72	43	29	57.5	75	40	35	43.5	63	24	39	43.0	64	22	42
11	52.0	70	34	36	59.5	78	41	37	44.0	65	23	42	45.5	68	23	45
12	64.5	80	49	31	54.0	70	38	32	46.0	68	24	44	35.0	55	15	40
13	60.0	76	44	32	52.5	70	35	35	41.5	62	21	41	29.0	48	10	38
14	57.5	75	40	35	48.5	64	33	31	41.5	58	25	33	32.5	50	15	35
15	59.5	79	40	39	51.0	70	32	38	34.0	48	20	28	33.0	54	12	42
16	58.5	75	42	33	47.5	65	30	35	25.0	40	10	30	32.0	52	12	40
17	66.0	89	43	46	47.0	64	30	34	35.0	55	15	40	35.5	57	14	43
18	67.0	89	45	44	50.0	68	32	36	39.5	59	20	39	36.0	59	13	46
19	64.0	88	40	48	54.5	74	35	39	33.5	50	17	33	28.5	47	10	37
20	62.5	80	45	35	54.0	75	33	42	33.0	51	15	36	24.0	40	8	32
21	65.5	83	48	35	49.5	70	29	41	34.5	49	20	29	−5.0	10	−20	30
22	67.0	85	49	36	51.5	75	28	47	51.5	60	43	17	20.0	40	0	40
23	67.0	86	48	38	55.0	79	31	48	40.5	52	29	23	45.0	50	40	10
24	63.5	83	44	39	54.5	79	30	49	38.0	50	26	24	44.0	50	38	12
25	60.0	80	40	40	47.0	70	24	46	27.0	41	13	28	42.0	49	35	14
26	68.5	89	48	41	51.0	72	30	42	32.0	49	16	33	33.0	44	22	22
27	72.0	93	51	42	56.5	79	34	45	31.5	48	15	33	30.5	40	21	19
28	71.5	90	53	37	54.0	78	30	48	41.5	59	24	35	31.0	40	22	18
29	71.5	89	54	35	47.0	70	24	46	40.0	60	20	40	29.0	38	20	18
30	69.0	88	50	38	52.0	76	28	48	44.5	65	24	41	29.5	40	19	21
31					54.0	79	29	50					36.0	50	22	28
Sum.	1940.5	2476	1405	1071	1747.0	2390	1104	1286	1209.0	1735	683	1052	1112.0	1606	618	988
Mean.	64.6	82.5	46.8	35.7	56.3	77.1	35.6	41.5	40.3	57.8	22.7	35.1	35.9	51.8	19.9	31.9

WHEATLAND.

The meteorological observations are reported by M. R. Johnston, Superintendent of the Experiment Farm. Temperature, precipitation and sunshine are observed, the results of the two first named being given in tables XII. and XIII. May had the largest number of stormy days, which somewhat retarded farm work. September was the sunniest month. A light hail storm was reported June 15 and several thunder storms were observed, but doing no damage. No high winds were reported.

Wheatland is located at an altitude of 4,800 feet. It is situated upon the undulating plateau which extends from the Laramie range of mountains, along the North Platte river into Nebraska. It is subject at times to the hot, dry winds of the plains, but they are not destructive. The season of growth is long, warm and favorable to crops, while the winters are not severe.

SUMMARY.

Highest temperature, 109, July 21.
Warmest day (for 24 hours), July 21.
Lowest temperature, —21, January 11.
Coldest day (for 24 hours), January 18.
Mean temperature for the year, 49.2.
Greatest daily range of temperature, 57, March 17.
Least daily range of temperature, 1, January 16.
Mean daily range of temperature for the year, 29.4.
Greatest monthly precipitation, 4.90 inches, in May.
Least monthly precipitation, 0.0 in September.
Greatest precipitation during any single storm, 1.30 inches, May 13.
Total precipitation, 14.51 inches. (See Table XIII.)
Light frosts June 6 and October 15, Killing frost October 22.

Table XIII. **PRECIPITATION, 1892.**

PLACE.	JAN.	FEB.	MARCH	APRIL	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL.
Laramie...	0.01	0.36	0.52	0.19	1.16	3.97	2.22	0.14	Trace.	3.96	Trace.	0.20	12.73
Lander....	0.35	Trace.	1.63	4.89	3.09	0.95	2.20	0.62	Trace.	0.00	0.89	1.36	11.94
Saratoga...	0.20	0.47	0.50	1.85	2.65	0.63	Trace.	0.10	0.00	1.60	0.10	0.81	8.91
Sheridan...	1.94	0.85	0.45	1.91	2.21	3.29	0.30	1.54	0.12	1.91	0.57	1.17	16.26
Sundance..	2.15	0.46	2.38	4.58	2.36	3.26	1.14	1.95	0.46	0.55	4.00	1.40	24.69
Wheatland.	0.70	0.90	0.45	2.35	4.90	1.50	0.01	1.10	0.00	1.50	0.90	0.20	14.51
*Bate's P'rk Freeland.	......	......	0.90	1.22	1.13	1.31	0.74	0.70	......	2.10	0.50	5.80	14.40
*Trelona ..	......	......	.....	4.57	5.00	4.90	1.85	0.63	0 00	6.13	0.49	0.49	24.06
*Inyan K'ra	......	......	......	.....	3.80	2.74	1.12	2.66	0.32	1.42	0.50	1.50	14.06
*Hat Creek.	......	......	......	.....	......	......	0.72	1.70	Trace.	2.10	0.40	0.10	5.02
*Sybille ...	......	......	.....	.....	......	0.40	1.53	0.83	Trace.	1.13	......	1.01	4.90
*Alamo....	......	......	.....	......	......	......	......	......	......	0.55	0.56	0.99	2.10

*For observer see page 3.

Table XII. **TEMPERATURE.**

	BATE'S PARK.*			INYAN KARA.*		
	Highest†	Lowest.†	Mean.	Highest†	Lowest.†	Mean.
March.....	68	2	34.1	....	....	....
April......	65	28	30.4	....	....	....
May......	80	30	47.2	80	30	49.1
June	90	32	60.6	84	40	51.0
July.......	104	40	71.5	94	48	74.1
August.....	98	40	67.6	94	52	73.3
September..	....	....	....	84	40	62.2
October....	88	28	50.8	80	36	51.1
November..	68	12	35.8	50	2	35.3
December..	62	—10	24.1	50	—14	19.4

*For observer see page 3

†From observed readings.

NOTE.—Bate's Park, observed at 7 a. m., 2 p. m. and 9 p. m.; Inyan Kara, observed at 7 a. m. and 2 p. m.

NOTES ON CLIMATE.

Differences in altitude and exposure cause a diversity of climate in the different parts of the state treated in this bulletin. With the exception, perhaps, of the extreme southwestern portion and the Big Horn Basin, all portions of the state are well represented by the six Experiment Farms. It is probable, therefore, that the average annual mean temperature given in the general summary for 1892, is near the mean temperature for the whole State.

The amount of precipitation varying so greatly in different localities, the average annual precipitation given cannot be relied upon as the average rainfall for the State. There are large areas over which the rainfall is less than

in several of the places named, which would decrease the general average.

As in other parts of the arid region the climate of the State is characterized by comparatively few stormy days and a large amount of sunshine; the air is dry giving low relative humidities and dew-points.

The southern and western parts of the State are at high altitudes, from 5,500 feet to over 7,000 feet. The mean annual temperature is correspondingly lower, but the cold is not more intense in winter than at lower altitudes. On these high plateaus, which are not sheltered by mountains, there is a large amount of wind, as indicated by the observations at Laramie, though the amount is not as great as in Eastern Kansas.

On still clear nights the terrestrial radiation is great, which may cause light frosts late and early in the season.

In general the climate is favorable to the production of hay, the cereals, flax, root crops, strawberries and other hardy small fruits, while in sheltered positions the more hardy orchard fruits are successfully grown.

In the eastern, central and northern portions the altitude is lower, from 5,500 feet to 3,500 feet. The growing season is longer and climate favorable to all crops grown in adjoining States. In the northeastern portion crops are matured without irrigation, though drouth is sometimes felt when the rainfall is not distributed through the growing season. The spring of 1892 was remarkable for the large amount of precipitation, giving crops and grass an early start and good growth.

NOTE.—The present Bulletin is a full report on the climate of the State for 1892, as observed by the Experiment Station. It is designed that future Bulletins of this department shall contain only brief notes and summaries or reports of results in special lines of research.

GENERAL SUMMARY, 1892.

Highest temperature, 109, at Wheatland, July 21.

Lowest temperature, —46, at Sheridan, January 11.

Highest annual mean temperature, 49.2, Wheatland.

Lowest annual mean temperature, 40.5, Laramie.

Average annual mean temperature for six Experiment Stations, 43.1.

Greatest daily range of temperature, 57, Lander, December 22, and Wheatland, March 17.

Greatest annual mean daily range of temperature, 29.4, at Wheatland.

Lowest annual mean daily range of temperature, 22.6, at Sundance.

Average annual mean daily range of temperature for the six Experiment Stations, 26.7.

Greatest annual precipitation, 24.69 inches, at Sundance.

Lowest annual precipitation, 8.91 inches, Saratoga.

Average annual precipitation for 1892 at Experiment Farms, 14.84 inches.

NOTE.—The thermometers at Wheatland are not kept in the regular instrument house of the weather service, as at the other Stations, but are located in a sheltered position, which would probably give little difference in temperature. However, this fact should be borne in mind in considering the above highest temperature, as it may be excessive.

UNIVERSITY OF WYOMING.

Agricultural College Department.

WYOMING EXPERIMENT STATION,

LARAMIE, WYOMING.

BULLETIN NO. 11.

FEBRUARY, 1893.

CROP REPORT FOR 1892.

BY THE DIRECTOR AND SUPERINTENDENT LARAMIE FARM.

Bulletins will be sent free upon request. Address: Director Experiment Station, Laramie, Wyo.

WYOMING
Agricultural Experiment Station.

UNIVERSITY OF WYOMING.

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WYOMING UNIVERSITY EXPERIMENT GROUNDS,
THE HORTICULTURIST IN CHARGE

INTRODUCTION.

A. A. JOHNSON.

For over a year this Station has been giving considerable thought preparatory to issuing a bulletin that would be helpful to the cattle industry in Wyoming. While our plans were in a formative state, the Bureau of Animal Industry of the Department of Agriculture at Washington published their Report on Diseases of Cattle and Cattle Feeding. In the back part of this valuable report is an able article on the "Feeding and Management of Cattle," by Prof. W. A. Henry, Ph. D., Professor of Agriculture and Director of the Wisconsin Agricultural Experiment Station. This paper is, perhaps, the most concise and able article ever written on the management and feeding of cattle from a practical standpoint, and just suited to the new conditions in Wyoming.

This article being a part of a large and costly report, published by the Department of Agriculture, its circulation must necessarily be limited. As this article covers the field of facts which ought to be known by every stockman in Wyoming, the Wyoming Agricultural Experiment Station, having secured permission from Dr. Henry and the Department at Washington, reprints as a Bulletin this splendid paper on "The Feeding and Management of Cattle." This paper has received the approval of our Station staff of workers, and therefore goes forth with the scientific endorsement of the Wyoming Agricultural Experiment Station.

The Feeding and Management of Cattle.

By W. A. HENRY,

Professor of Agriculture and Director of the Agricultural Experiment Station, University of Wisconsin.

[Reprinted, by permission, from Special Report on Diseases of Cattle and Cattle Feeding by the Bureau of Animal Industry, Department of Agriculture, Washington, D. C.]

Ten years ago the cattle business of the country was undergoing a great and wonderful change; companies were being formed to control vast herds which were to range unrestrained over the western plains, with no provisions as to feed except the seeming abundance of natural grasses, and little care except rounding up and branding. With this unprecedented expansion came the natural attendant of good prices for cattle of almost any quality in the older agricultural sections, and beef-producers everywhere made money. It mattered little in Illinois or Iowa whether a fattening steer ate half a bushel of corn a day or only a third of a bushel, for there was profit in the business, and giving attention to little details about feeding was not to be thought of in such times. Those farmers who had advanced in dairying far enough to make fine goods likewise found high prices awaiting their products and were satisfied to continue their feeding operations with little thought of closer economy.

But times have changed; the young stock bought from our western farms at good prices to go to the plains proved fruitful and multiplied amazingly, and hordes of their descendants have been coming back year after year

to aid in depressing the cattle market. Dairy products have kept up wonderfully well, but I do not think we can hope for higher prices at any time than have ruled the past year.

We are passing through a period of falling prices which began years ago with the manufacturer, carrier and merchant, and which is now bearing down most heavily upon our agricultural industries. The marvelous advancement made in transportation facilities the world over has brought about a new set of conditions; stock, bred thousands of miles apart and reared under the most diverse conditions of range, climate, feed and cost of production, meet at the great commercial centers, to be sold according to supply and demand, quality alone being the varying factor. The problem is still further complicated by the production of meat in distant parts of the world, which is now shipped as frozen carcasses to the great meat-consuming centers. Nor is there any going backward in this matter. We cannot hope that any of the potent forces now at work, which all tend to equalizing the markets, will cease for even a single day. While legislation may aid in some minor matters, the general law that supply and demand rule prices remains inviolable. I know of but two means of successfully meeting the sharp competition which is certain to continue: first, by making products of a higher quality, and, second, by cheapening the cost of production.

While lack of space prevents more than a mere mention of the subject, I cannot help but urge that our farmers and stockmen endeavor to secure the very best machines possible for converting coarse feeds into beef and dairy products. To have any other than the best cattle obtain-

able for the specific purpose in view is to start handicapped in what is sure to be a severe contest.

In the other line of improvement there is also much opportunity for careful study and the exercise of discretion and good judgment. The farmer and stockman should have a clear knowledge and good understanding of the several different kinds of stock foods, their relative values, and the combinations of those best suited for different animals in different stages of growth and usefulness. With an earnest desire to help the feeder in the study of the great problem which constantly confronts him this chapter is written.

SCIENCE AND STOCK-FEEDING.

Fifty years ago those great lights in agricultural chemistry, Liebig, of Germany, Boussingault, of France, and Lawes and Gilbert, of England, began investigations of agricultural problems, many of which were immediately helpful to agriculture and all tended to awaken an interest in an art previously neglected by scientific investigators. Out of this awakening grew the movement for a better knowledge of animal nutrition, and how and by what means the products of our fields were manufactured into flesh, milk and other animal products. Germany has led the world in founding agricultural experiment stations, and to German chemists and animal physiologists are we largely indebted for what is known in this most important field. Though the investigations began over a generation ago and have occupied the energies of many eminent men, the records of whose observations fill hundreds of books, so great is the subject that it now seems but fairly begun. Still, much has been found that is of great importance and utility to the practical stockman.

THE GERMAN FEEDING TABLES.

Mainly through the studies of the German investigators has come the first attempt to place the great art of feeding on a scientific basis. The various investigations in animal nutrition have been summarized and set forth in the writings of Wolff and Kuehn, of Germany, and very ably presented to English readers by Dr. Armsby in his "Manual of Cattle Feeding." The leading features of this system have also been given in some of the reports of our American experiment stations. Being largely the result of German investigations and formulations, it is naturally spoken of as the "German System," while the tables of data relative to feeding stuffs and feeding rations are usually spoken of as the German feeding tables or the tables of Kuehn or Wolff, as compiled and arranged by those writers.

Table I. of this chapter presents the studies of chemists both in this country and abroad, summarized and placed in the most available condensed form. The figures giving the composition of fodders are in most cases taken from the compilation of analyses of American fodders by Dr. E. H. Jenkins and A. L. Winton, jr., first published in Volume II. of the Experiment Station Record, Department of Agriculture (pp. 702–709). That portion of the table which gives the digestible constituents was derived from the first part of the table through coefficients of digestibility given by Dr. Jenkins in the Report of the Connecticut Experiment Station for 1886, or from later sources.

There was a time when farmers thought that science, and even agricultural science, could bring little that would be helpful to them, but happily that day is past,

and I approach the scientific side of the subject of feeding with no fear whatever that it will prove uninteresting to my readers, but rather that a large majority will gladly avail themselves of any opportunity which may offer for a better understanding of the great problem of stock feeding. It will be remembered in studying the table that like most first attempts at definite expression of difficult and complex problems, what is here given is but a crude expression of important laws, and that the tables will no doubt be considerably modified or perhaps supplanted in time by better ones, when the animal physiologist has enlarged our knowledge of what becomes of plant constituents in the animal body. In its present form it contains so much of value that it will well repay all the study and time devoted to it.

WHAT THE TABLE SHOWS.

This table looks formidable enough, but when we have studied it, column by column, I do not think it will be regarded as difficult, nor will its contents seem dry to farmer readers. In the first column are given the names of fodders, all of which are used in some portion of the country for stock-feeding purposes ; next to this comes a statement of the number of analyses from which the succeeding average figures are derived.

Water.—In the laboratory the scales of the chemist are so delicate that he can weigh a thimbleful of corn meal with a smaller proportional error than the farmer weighs a wagon load of corn. In a small dish on these scales he places a sample of the fodder with which he is to work and determines its weight. Placing this in an oven it is dried at a temperature of 212° F. for several hours and weighed again. The heat has driven off the water and the

difference in the two weights represents the water which the sample contained. The average amount of water found in the various samples in the list is placed in the column headed "Water." It will be seen that the proportion of water in the different feed stuffs varies greatly. In 100 pounds of pasture grass there are 75.3 pounds of water on an average; with roots the amount reaches as high as 90 pounds, while for straw and grain it varies from 8 to 16 pounds of water per hundredweight. Water is the great vehicle for transporting food both in the plant and animal, and, while of the highest importance to both, it is so universal and abundant that we need not further consider it at this time.

Ash.—Carefully burning a sample of the fodder, the chemist determines the ash. By the table we find that in 100 pounds of pasture grass there are 2.5 pounds ash, while in clover hay there are over 6 pounds. One hundred pounds of shelled corn contains only 1.5 pounds of ash, while the same weight of wheat bran yields over 5 pounds. The ash elements in plants are very important, since they enter into the composition of all the tissues of the body in a small way, and form the larger part of the bones. Experience shows that when the stockman feeds his animals abundantly with a variety of nutritious foods they are amply supplied with ash for all necessities of the body, so that as with water this part of the plant substance need not receive special attention when considering the constituents of feeds, though there are a few special cases where the supply of ash is apt to be lacking, even when the animals are seemingly well nourished.

Crude protein marks a very important group of substances in fodders, the characteristic element of all being

nitrogen. The chemist has found that protein compounds weigh 6.25 times as much as the nitrogen contained ; by a complicated process he determines the weight of nitrogen in a sample of feed, and multiplies this by 6.25, which gives the crude protein. A considerable portion of the bones, the ligaments which hold the bones together, the muscles which surround the bones, the tendons which bind the muscles to the bone, and the great nervous system, as well as the internal organs of the body, are largely composed of protein compounds. From this we can readily understand that protein is a very important part of stock foods, being especially needed with young, growing animals. We turn with interest to the table and note that the total crude protein in pasture grass is 4 pounds to the hundred, while in oats there are 11.8 pounds, in corn 10.5 pounds, and nearly 33 pounds in 100 of linseed meal.

Crude fiber is determined by boiling a sample of the fodder first with a weak alkali, and then with a weak acid in order to dissolve out as much of the substance as possible. The undissolved portions represent the tougher parts of the framework of the plant, usually termed cellulose or crude fiber. The table shows that a large portion of rye straw is crude fiber, while in grains like corn or wheat the amount is very small.

Ether extract.—On another sample of the fodder the chemist places ether, which dissolves out whatever fats and wax it contains, and this dissolved portion is called the ether extract or crude fat. Hay and straw contain very little fat, and still less is found in mangolds or turnips, while corn contains considerable, and oil meal and cotton-seed meal a relatively large amount.

Nitrogen-free extract signifies what is left of the organic matter of the plant after deducting the preceding groups of elements. It contains starch, sugar, dextrine and gums.

Carbohydrates.—The nitrogen-free extract and the crude fiber are grouped together under the term carbohydrates. The leading function of the carbohydrates is to furnish fuel for the animal body. Portions not needed for immediate wants may be converted into fat and stored up in the tissues awaiting future demands.

The figures given in all the columns of the table we have passed over are derived from analysis in the laboratory, and represent the total amount of each of the plant constituents in the several groups. Thus far the investigation is purely a chemical one, though the grouping of the substances has some relation to the uses of the food in the animal system. Having learned the amount of each of the constituents in a given fodder, the chemist proceeds to feed it to some farm animal, usually an ox or a sheep, in order to ascertain what portion of each is digestible. The value of gold ore is not rated by the total amount of gold contained, but rather by that portion which can be recovered by practical processes; so with our feeds, only those portions which can be digested and utilized by the animal are really valuable. The results of digestion trials are grouped in the last columns of the table under the head "Per cent of digestible matter," and these data have cost the chemist and animal physiologist much patient labor; even now the results are crude and far from satisfactory.

Let us study this table item by item, as we did the first part. We learn that while the total crude protein in pasture grass is 4 in 100 pounds, the digestible crude pro-

tein is 2.8 pounds in a hundredweight. The digestible carbohydrates, the compounds of crude fiber and nitrogen-free extract are 12.3 pounds, and the digestible ether extract 0.6 pound. The chemist has found that a pound of fat will give about 2.2 times as much heat as a pound of carbohydrates. Since the fats serve the same purpose in the body as the carbohydrates, we can reduce the fat found in a fodder to a carbohydrate equivalent by multiplying it by 2.2. To obtain the nutritive ratio expressed in the last column of the table, the digestible fat is multiplied by 2.2 and added to the digestible carbohydrates, and the sum divided by the digestible protein. The nutritive ratio of pasture grass is 1 : 4.9; that is, for every pound of digestible protein in pasture grass there are 4.9 pounds of digestible carbohydrates and carbohydrate equivalents. The following table summarizes the results of analyses in digestion trials as just explained:

TABLE I.—*Average composition of American feeding stuffs.*

Feeding Stuffs.	Number of analyses.	Percentage composition.						Per cent digestible matter.			Nutritive ratio.
		Water.	Ash.	Crude protein.	Crude fiber.	Nitrogen-free extract	Ether extract.	Crude protein.	Carbohydrates.	Ether extract.	
Green fodders and silage.											
Pasture grass	10	75.3	2.5	4.0	5.9	11.4	.9	2.8	12.3	.6	1 : 4.9
Red top (*Agrostis vulgaris*) in bloom	5	65.3	2.3	2.8	11.0	17.7	.9	2.0	20.5	.6	1 : 10.9
Orchard grass (*Dactylis glomerata*) in bloom	4	73.0	2.0	2.6	9.4	15.8	.9	1.8	18.1	.6	1 : 10.8
Kentucky blue grass (*Poa pratensis*)	18	65.1	2.8	4.1	9.1	17.6	1.3	2.9	19.2	.8	1 : 7.2
Timothy (*Phleum pratense*)	56	61.6	2.1	3.1	11.8	20.2	1.2	1.9	21.9	.7	1 : 12.3
Maize (corn) fodder:											
Flint varieties	40	79.8	1.1	2.0	4.3	12.1	.7	1.5	12.0	.5	1 : 8.7
Dent varieties	63	79.0	1.2	1.7	5.6	12.0	.5	1.2	12.8	.4	1 : 11.8
Sweet varieties	21	79.1	1.3	1.9	4.4	12.8	.5	1.4	12.6	.4	1 : 9.6
Red clover	43	70.8	2.1	4.4	8.1	13.5	1.1	2.9	14.1	.7	1 : 5.4
Alsike clover in bloom	4	74.8	2.0	3.9	7.4	11.0	.9	2.5	11.1	.5	1 : 4.9
Alfalfa (lucerne)	23	71.8	2.7	4.8	7.4	12.3	1.0	3.6	11.4	.4	1 : 3.4
Cowpea	10	83.6	1.7	2.4	4.8	7.1	.4	1.3	7.7	.2	1 : 6.3
Sorghum (whole plant)	11	79.4	1.1	1.3	6.1	11.6	.5	.8	12.7	.4	1 : 17.0
Rye fodder	7	76.6	1.8	2.6	11.6	6.8	.6	2.1	14.1	.4	1 : 7.1
Oat fodder	5	62.2	2.5	3.4	11.2	19.3	1.4	2.7	22.7	1.0	1 : 9.2
Corn silage	99	79.1	1.4	1.7	6.0	11.1	.8	1.2	11.8	.6	1 : 10.9
Sorghum silage	6	76.1	1.1	.8	6.4	15.3	.3	.6	14.9	.2	1 : 25.6
Red clover silage	5	72.0	2.6	4.2	8.4	11.6	1.2	2.2	10.0	.5	1 : 5.0
Hay and dry coarse fodders.											
Corn (maize) fodder, field cured	35	42.2	2.7	4.5	14.3	34.7	1.6	2.8	29.5	1.0	1 : 11.3
Corn (maize) stover, field cured	60	40.5	3.4	3.8	19.7	31.5	1.1	2.0	34.1	.6	1 : 17.7
Hay from mixed meadow grasses	11	16.0	4.6	6.4	29.9	41.0	2.1	3.6	42.7	1.0	1 : 12.5
Timothy hay	68	13.2	4.4	5.9	29.0	45.0	2.5	3.0	43.9	1.2	1 : 15.5
Hay from Hungarian grass	12	7.7	6.0	7.5	27.7	49.0	2.1	4.5	46.4	1.0	1 : 10.8
Red clover hay	38	15.3	6.2	12.3	24.8	38.1	3.3	6.5	34.9	1.6	1 : 5.9
Alsike hay	9	9.7	8.3	12.8	25.6	40.7	2.9	6.8	36.9	1.4	1 : 5.9
Alfalfa hay	21	8.4	7.4	14.3	25.0	42.7	2.7	7.6	37.8	1.3	1 : 5.4
Cowpea hay	8	10.7	7.5	16.6	20.1	42.2	2.9	8.1	37.3	1.7	1 : 5.1
Wheat straw	7	9.6	4.2	3.4	38.1	43.4	1.3	.6	38.3	.5	1 : 65.7
Rye straw	7	7.1	3.2	3.0	38.9	46.6	1.2	.6	40.6	.4	1 : 69.1
Oat straw	12	9.2	5.1	4.0	37.0	42.4	2.3	1.6	41.7	.7	1 : 27.0

Roots and Tubers.											
Mangels	9	90.9	1.1	1.4	.9	5.5	.2	1.1	4.8	....	1 : 4.4
Rutabagas	4	88.6	1.2	1.2	1.3	7.5	.2	.9	7.1	....	1 : 8.9
Turnips	3	90.5	.8	1.1	1.2	6.2	.2	.6	5.5	....	1 : 9.2
Red beets	9	88.5	1.0	1.5	.9	8.0	.1	.9	7.6	....	1 : 8.4
Sugar beets	19	86.5	.9	1.8	.9	9.8	.1	1.1	9.3	....	1 : 8.5
Carrots	8	88.6	1.0	1.1	1.3	7.6	.4	1.0	7.1	....	1 : 7.1
Potatoes	12	78.9	1.0	2.1	.6	17.3	.1	1.4	16.1	....	1 : 11.5
Grains and other seeds.											
Corn (maize):											
Dent	86	10.6	1.5	10.3	2.2	70.4	5.0	7.0	63.4	3.9	1 : 10.3
Flint	68	11.3	1.4	10.5	1.7	70.1	5.0	7.1	63.0	3.9	1 : 10.1
Sweet	26	8.8	1.9	11.6	2.8	66.8	8.1	7.9	61.4	6.3	1 : 9.7
Average for all varieties and analyses	208	10.9	1.5	10.5	2.1	69.6	5.4	7.1	62.7	4.2	1 : 10.1
Wheat, spring varieties	13	10.4	1.9	12.5	1.8	71.2	2.2	9.8	55.3	1.8	1 : 6.1
Winter varieties	262	10.5	1.8	11.8	1.8	72.0	2.1	9.2	55.9	1.8	1 : 6.5
Average for all varieties and analyses	310	10.5	1.8	11.9	1.8	71.9	2.1	9.3	55.8	1.8	1 : 6.4
Barley	10	10.9	2.4	12.4	2.7	69.8	1.8	9.5	66.1	1.2	1 : 7.2
Rye	6	11.6	1.9	10.6	1.7	72.5	1.7	8.3	65.5	1.2	1 : 8.3
Oats	30	11.0	3.0	11.8	9.5	50.7	5.0	9.1	44.7	4.1	1 : 5.9
Buckwheat	8	12.6	2.0	10.0	8.7	64.7	2.2	7.7	49.2	1.8	1 : 6.9
Sorghum seed	10	12.8	2.1	9.1	2.6	69.8	3.6	7.0	52.1	3.1	1 : 8.4
Pease	2	10.5	2.6	20.2	14.4	51.1	1.2	18.0	56.0	.9	1 : 3.2
Soja bean	8	10.8	4.7	34.0	4.8	28.8	16.9	29.6	17.7	15.9	1 : 1.8
Cowpea	5	14.8	3.2	20.8	4.1	55.7	1.4	18.1	34.5	1.3	1 : 2.1
Flaxseed, ground	2	8.1	4.7	21.6	7.3	27.9	30.4	18.5	26.0	27.4	1 : 4.7
Mill products and refuse feeds.											
Corn (maize) meal, bolted	77	15.0	1.4	9.2	1.9	68.7	3.8	6.3	61.8	3.0	1 : 11.0
Corn and cob meal	7	15.1	1.4	8.5	6.6	64.8	3.5	6.5	56.3	2.9	1 : 9.6
Corncob	18	10.7	1.4	2.4	30.1	54.9	.5	1.6	43.9	.3	1 : 27.8
Corn bran	2	10.9	1.7	9.4	4.8	67.3	5.9	6.2	50.9	3.4	1 : 9.4
Wheat bran from roller mills	7	12.0	5.6	16.1	8.4	53.7	4.2	12.6	44.1	2.9	1 : 4.0
Wheat bran, old process	9	12.0	4.9	13.0	8.1	58.2	3.8	10.1	47.5	2.6	1 : 5.3
Wheat bran, all analyses	88	11.9	5.8	15.4	9.0	53.9	4.0	12.0	44.5	2.8	1 : 4.2
Wheat shorts	12	11.8	4.6	14.9	7.4	56.8	4.5	11.6	45.4	3.2	1 : 4.5
Wheat middlings	33	12.1	3.4	15.7	4.7	60.2	4.0	12.2	47.2	2.9	1 : 4.4
Wheat screenings	10	11.6	2.9	12.5	4.9	65.1	3.0	9.8	51.0	2.2	1 : 5.7
Barley meal	3	11.9	2.6	10.5	6.5	66.3	2.2	8.1	57.7	2.2	1 : 7.7
Rye bran	7	11.6	3.6	14.7	3.5	63.8	2.8	9.7	48.0	1.6	1 : 5.3
Rye shorts	1	9.3	4.9	18.0	5.1	59.9	2.8	11.9	45.1	1.6	1 : 4.1
Oatmeal	6	7.9	2.0	14.7	.9	67.4	7.1	11.3	49.9	5.8	1 : 5.5

TABLE I.—*Average composition of American feeding stuffs*—Continued.

Feeding Stuffs.	Number of analyses.	Petcentage composition.						Per cent digestible matter.			Nutritive ratio.
		Water.	Ash.	Crude protein.	Crude fiber.	Nitrogen-free extract.	Ether extract.	Crude protein.	Carbohydrates.	Ether extract.	
Mill products and refuse feeds—Continued											
Oat shorts	1	5.5	3.9	18.1	8.9	57.3	6.2	14.1	46.2	4.5	1 : 4.0
Oat dust	2	6.5	6.9	13.5	18.2	50.2	4.8	8.9	38.4	2.8	1 : 5.0
Oat feed	4	7.7	3.7	16.0	6.1	59.4	7.1	12.5	47.0	5.0	1 : 4.6
Buckwheat bran	2	10.5	3.0	12.4	31.9	38.8	3.3	7.4	30.4	1.9	1 : 4.7
Buckwheat shorts	2	11.1	5.1	27.1	8.3	40.8	7.6	21.1	33.5	5.5	1 : 2.2
Buckwheat middlings	6	12.7	5.1	28.2	4.2	42.3	7.5	22.0	33.4	5.4	1 : 2.1
Rice hulls	3	8.2	13.2	3.6	35.7	38.6	.7	2.4	30.4	.4	1 : 13.0
Rice bran	5	9.7	10.0	12.1	9.5	49.9	8.8	8.0	36.9	5.1	1 : 6.0
Malt sprouts	5	9.6	5.9	24.8	11.0	47.0	1.7	19.8	36.2	1.7	1 : 2.1
Brewers' grains	15	75.7	1.0	5.4	3.8	12.5	1.6	3.9	9.5	1.3	1 : 3.2
Brewers' grains, dried	5	7.7	3.6	22.2	12.3	47.9	6.3	16.2	35.5	5.3	1 : 2.9
Germ meal	3	8.6	1.0	10.9	10.2	64.0	5.4	9.3	63.6	4.1	1 : 7.8
Gluten meal	32	9.6	.7	29.4	1.6	52.4	7.4	25.0	49.4	5.6	1 : 2.5
Starch feed, wet	12	65.4	.3	6.1	3.1	22.0	3.1	5.1	21.7	2.4	1 : 5.3
Hominy feed	12	11.1	2.5	9.8	3.8	64.5	8.3	8.3	61.9	6.3	1 : 9.1
Cotton-seed hulls	10	9.9	2.9	4.2	47.4	33.2	2.2	1.0	26.2	1.8	1 : 30.2
Cotton-seed meal	37	8.2	7.2	42.4	5.6	23.8	12.9	36.9	18.1	12.3	1 : 1.2
Linseed meal, old process	21	9.2	5.7	32.9	8.9	35.4	7.9	28.3	32.2	7.1	1 : 1.7
Linseed meal, new process	14	10.1	5.8	33.2	9.5	38.4	3.0	27.2	31.8	2.7	1 : 1.4
Palm-nut meal	3	8.3	3.7	14.4	21.4	38.9	3.3	13.5	54.1	2.9	1 : 5.4
Apple pomace	7	76.7	.5	1.4	3.9	16.2	1.3	1.0	17.2	.9	1 : 19.2
Dried blood	3	8.5	4.7	84.4	....	....	2.5	59.1	....	2.3	1 : 0.1
Meat scraps	144	10.7	4.1	71.2	....	.3	13.7	68.4	.3	13.5	1 : 0.4
New milk from cows	793	87.2	.7	3.6	....	4.9	3.7	3.5	4.8	3.7	1 : 3.7
New milk from goats	38	85.7	.8	4.3	....	4.5	4.8	4.2	4.4	4.8	1 : 3.6
New milk from ewes	33	80.8	.9	6.5	....	4.9	6.9	6.4	4.8	6.9	1 : 3.1
New milk from mares	47	90.8	.4	2.0	....	5.7	1.2	2.0	5.5	1.2	1 : 4.1
New milk from sows	7	84.6	1.1	6.4	....	3.2	4.8	6.3	3.1	4.8	1 : 2.2
Skimmed milk	96	90.4	.7	3.3	....	4.7	.9	3.1	4.7	.8	1 : 2.1
Skimmed milk, centrifugal	7	90.6	.7	3.1	....	5.3	.3	2.9	5.2	.3	1 : 2.0
Buttermilk	85	90.1	.7	4.0	....	4.0	1.1	3.9	4.0	1.1	1 : 1.7
Whey	46	93.4	.7	.9	....	4.8	.3	.8	4.7	.3	1 : 6.7

Before passing to the next division of the subject, let us review briefly how animals grow and live. All animals live directly or indirectly on foods furnished by plants. The plant grows through the union of chemical compounds taken from the air and soil and brought up into its structure, through that mysterious principle called life, by the energy of the sun. The sun pouring its rays day after day in summer time, furnishes the energy which welds the simpler compounds into the more complex ones of the plant organism. In summer time our animals crop the grasses of the fields, and in the fall man gathers plants and their seeds into barns and storehouses that in winter time he may pass them over to his farm animals for sustenance and growth. The compounds in the plant substance are separated in the laboratory of the stomach and digestive tract and carried about the body, where they are built up into the body tissues or stored up as fat, or they may be burned up at once if needed to give out energy and warmth. Dr. Armsby has happily used the figure of a coiled spring to illustrate this wonderful phenomenon. The energy of the sun in summer time winds up the spring in the plant, and when the animal consumes the plant the spring is unwound and exhibits just as much energy in the unwinding as was used in winding it up.

In studying these plant compounds we have divided those which need especial attention into three groups, under the heads protein, carbohydrates, and fat. As already shown, the protein compounds are that portion of the food material which may go to build up the muscular portion of the animal body. Among the list of food articles used by man rich in protein are the lean part of meat, the white of egg, the cheese of milk, and the gluten of

—(5)

wheat ; of stock foods rich in protein we have cotton-seed meal, oil meal, pease, wheat bran, clover and alfalfa hay. The first great use of protein is in building up the muscular portion of the body, but we should not forget that it also gives off heat and energy in being broken down to simpler compounds, and may also be converted into fat and stored up in the tissues of the body for future use.

Since the carbohydrates contain no nitrogen they cannot go to build up the muscular portion of the body, but nevertheless they are of great importance and form the largest part of foods used by our farm animals. The first great use of carbohydrates is to furnish fuel for warming the body and enabling it to perform work. Of human foods rich in carbohydrates we have sugar and starch, both almost chemically pure, while the grain of wheat and corn are both very rich in carbohydrates. In animal foods corn, oat straw and cornstalks are all rich in carbohydrates. As the protein compounds may be called the muscle-formers, so the carbohydrates may be called the fuel or energy givers of the body. The fats in foods serve the same purpose as the carbohydrates, but are more potent, giving off more heat in burning. A pound of fat is generally regarded as 2.2 times as valuable as a pound of sugar or starch in food.

AMOUNT OF NUTRIENTS REQUIRED BY OUR FARM ANIMALS.

The next step in our study is to ascertain the amount of the several constituents in feeding materials required by different farm animals under varying conditions for maintenance, growth and fattening. Since the weights of our animals vary according to age and breed it is well to take some simple standard of weight, and for convenience

it has been placed at a thousand pounds. The needs of growing animals differ from those that are mature, and the requirements of work animals are not the same as those at rest or taking on fat. In Table II. is summarized the amount of digestible nutrients required by a thousand pounds, live weight, of farm animals.

To study this table let us take the first case—that of an ox at rest in his stall. This ox is supposed to weigh 1,000 pounds, and to be kept perfectly comfortable as to temperature and environment, and to do no work, neither gaining nor losing in weight. The amount of food required under these conditions will be the minimum for such an animal, of course. It will be found when we have furnished this ox with the digestible nutrients required that the total organic substance, which is the weight of the fodder, less the water and ash it contains, will amount to 17.5 pounds. Every beat of the heart, every respiration, the tension of the muscles while standing, all mean wear and destruction of muscular tissue. Indeed, every manifestation of life means the consumption of food to repair the waste of some portion of the body. The Germans have held that 0.7 of a pound of crude protein is necessary to make good this loss. For warming the body and running its machinery, if we may so speak, there are required 8 pounds of digestible carbohydrates and 0.15 pounds of ether extract. Adding the digestible protein, carbohydrates and ether extract together, we get a total of 8.85 pounds of total nutritive substance. If we multiply the digestible ether extract by 2.2 and add it to the digestible carbohydrates the sum is 8.33, which, divided by 0.7, gives a quotient of 12 in round numbers. That is, for every 1 pound of crude protein required by the ox, he needs 12

pounds of digestible carbohydrates or their equivalents in fat. Investigations by several American experimenters have shown that the amount of nutrients as stated by the Germans as only sufficient to maintain a thousand-pound ox is more than sufficient for that purpose under our conditions, and that the ox will make a small gain therefrom. Our work, however, has not progressed far enough to reconstruct even this portion of the table, so that we shall have to let it stand as stated by the Germans.

In the same table we learn that the ox heavily worked reduires 2.4 pounds of digestible protein per day, or three times as much as when at rest. We are not surprised at this, for when performing labor the muscles must be worn down much more rapidly than when an animal is idle. A milch cow of the same weight requires more protein and almost as much carbohydrates as the heavily worked ox. Though there is little tax on the muscles, yet a large amount of protein is needed for the cheese portion of the milk. To elaborate this, as well as the sugar and fat, makes a heavy demand for food by the dairy cow.

Table II. is compiled by the German scientist, Dr. Emil Wolff, and gives the amount of digestible substances he considers necessary by our farm animals:

TABLE II.—*Feeding standards.* (*According to Wolff.*)

[Per day and per 1,000 pounds, live weight.]

Animals, etc.	Total organic substance.	Nutritive (digestible) substances. Crude protein	Carbohydrates.	Ether extract.	Total nutritive substances.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
1. Oxen in rest in stall	17.5	0.7	8.0	0.15	8.85	1 : 12.0
2. Wool sheep, coarser breeds	20.0	1.2	10.3	0.20	11.70	1 : 9.0
Wool sheep, finer breeds	22.5	1.5	11.4	0.25	13.15	1 : 8.0
3. Oxen moderately worked	24.0	1.6	11.3	0.30	13.20	1 : 7.5
Oxen heavily worked	26.0	2.4	13.2	0.50	16.10	1 : 6.0
4. Horses moderately worked	21.0	1.6	10.0	0.50	12.10	1 : 7.0
Horses heavily worked	23.0	2.5	12.1	0.70	15.30	1 : 5.5
5. Milch cows	24.0	2.5	12.5	0.40	15.40	1 : 5.4
6. Fattening oxen, 1st period	27.0	2.5	15.0	0.50	18.00	1 : 6.5
Fattening oxen, 2d period	26.0	3.0	14.8	0.70	18.50	1 : 5.5
Fattening oxen, 3d period	25.0	2.7	14.8	0.60	18.10	1 : 6.0
7. Fattening sheep, 1st period	26.0	3.0	15.2	0.50	18.70	1 : 5.5
Fattening sheep, 2d period	25.0	3.5	14.4	0.60	18.50	1 : 4.5
8. Fattening swine, 1st period	36.0	5.0	27.5		32.50	1 : 5.5
Fattening swine, 2d period	31.0	4.0	24.0		28.00	1 : 6.0
Fattening swine, 3d period	23.5	2.7	17.5		20.20	1 : 6.5
9. Growing cattle:						
Age, months. — *Average live weight, per head.*						
2–3 — 165 lbs	22.0	4.0	13.8	2.0	19.8	1 : 4.7
3–6 — 330 lbs	23.4	3.2	13.5	1.0	17.7	1 : 5.0
6–12 — 550 lbs	24.0	2.5	13.5	0.6	16.6	1 : 6.0
12–18 — 770 lbs	24.0	2.0	13.0	0.4	15.4	1 : 7.0
18–24 — 940 lbs	24.0	1.6	12.0	0.3	13.9	1 : 8.0
10. Growing sheep:						
5–6 — 62 lbs	28.0	3.2	15.6	0.8	19.6	1 : 5.5
6–8 — 73 lbs	25.0	2.7	13.3	0.6	16.6	1 : 5.5
8–11 — 84 lbs	23.0	2.1	11.4	0.5	14.0	1 : 6.0
11–15 — 90 lbs	22.5	1.7	10.9	0.4	13.0	1 : 7.0
15–20 — 95 lbs	22.0	1.4	10.4	0.3	12.1	1 : 8.0
11. Growing fat pigs:						
2–3 — 55 lbs	42.0	7.5	30.0		37.5	1 : 4.0
3–5 — 110 lbs	34.0	5.0	25.0		30.0	1 : 5.0
5–6 — 137 lbs	31.5	4.3	23.7		28.0	1 : 5.0
6–8 — 187 lbs	27.0	3.4	20.4		23.8	1 : 6.0
8–12 — 275 lbs	21.0	2.5	16.2		18.7	1 : 6.5

From Tables I. and II. we are now in a position to calculate a ration for a fattening steer or a dairy cow. Let us form a ration for a dairy cow weighing 1,000 pounds and yielding a full flow of milk. Suppose we have at hand the following common feeding stuffs: Corn fodder, clover hay, bran, corn meal and cotton-seed meal. By the last table we find the requirements for a cow

weighing 1,000 pounds to be 2.5 pounds digestible protein, 12.5 pounds digestible carbohydrates, and 0.4 pound digestible ether extract.

We place these amounts at the head of our table at *A*:

TABLE III.—*Showing how to construct a ration for a dairy cow.*

	Nature and weight of food.	Organic matter.	Digestible. Protein.	Digestible. Carbohydrates.	Digestible. Ether extract.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
A.	Required by standard	24.0	2.5	12.5	0.4
B.	14 pounds fodder corn	7.71	0.39	4.13	0.14
	6 pounds clover hay	4.71	0.39	2.09	0.10
	5 pounds roller bran	4.12	0.63	2.20	0.15
	5 pounds ground corn	4.38	0.36	3.14	0.21
C.	First trial ration	20.92	1.77	11.56	0.60
	2 pounds cotton-seed meal	1.69	0.74	0.36	0.25
	Second trial ration	22.61	2.51	11.92	0.85

In order to properly distend the rumen, the feed should have a certain bulk, and will amount on the average to about 24 pounds of organic matter, which sum is placed in the first column. This portion of the table can vary more than any other without serious detriment. Having the requirements before us in the table, let us approximate it by combining several food materials from our list. For trial we will take 14 pounds of corn fodder. By adding the water given in Table I. to the ash and subtracting from 100, we have the total organic matter in 100 pounds of fodder corn. For 14 pounds of fodder corn the amount of organic matter is 7.71, which we place under the column headed "Organic matter." By Table I., again, we learn that the digestibe crude protein of field-cured fodder corn is 2.8 per 100 pounds; for 14 pounds it is 0.39. The digestible carbohydrates in the fodder corn is 29.5 for 100 pounds, and for 14 pounds 4.13. The ether ex-

tract in 100 pounds of fodder corn is 1 pound, and in 14 pounds is 0.14. We place these sums in their respective columns, which gives the total organic matter and digestible material for 14 pounds of fodder corn. In the same manner we find the organic matter and digestible nutrients in 6 pounds of clover hay, then in 5 pounds of bran, and, finally, 5 pounds of ground corn, all of which is summarized under *B* of the table. We next add the several columns to ascertain the total constituents. The sums are found under the first trial ration. We now compare this trial ration, which is the sum of the items under *B*, with the required ration at *A*. We notice that the organic matter is a little more than three pounds short of the requirements, and there is still about three-fourths of a pound of protein and a pound of carbohydrates lacking, while the ether extract is already 0.2 of a pound in excess. Our ration is short of the requirements, and to bring *B* still nearer *A* we add to the trial ration as given 2 pounds of cotton-seed meal, choosing this feed because we must add some substance rich in protein. Determining the nutrients in 2 pounds of cotton-seed meal we place them at *C*, and adding the items to the first trial ration, or *B*, we get the second trial ration. In the second trial ration we observe that the organic matter is 1.31 pounds short of the requirements, the protein .01 of a pound in excess, the carbohydrates 0.58 of a pound short, while ether extract is 0.45 pound in excess of requirements. We have learned that the ether extract is worth 2.2 times as much as the same weight of carbohydrates. We multiply the excess, 0.45 by 2.2 and find that the excess is equal to 0.99 of a pound of carbohydrates. This sum brings the carbohydrates above the required standard. Our second

trial ration is, therefore, slightly lacking in organic matter, but contains the full amount of protein required and a slight excess of carbohydrates or their equivalents. We find the nutritive ratio of this ration by multiplying the ether extract 0.85 by 2.2, adding it to the carbohydrates and dividing by 2.51, and obtain the nutritive ratio of 1 : 5.5, or about the requirements given in Table II. This is as close as we can expect to work in practice.

Having studied this problem over carefully, the student is in position to use Tables I. and II. in a study of the requirements of his stock and the feeds he has on hand. With a little patience feed combinations can be made which will conform to the requirements. I have gone over this problem carefully in order to show just how the tables are used. The student can select from the first table such feed stuffs as he has at hand or can secure, and from these construct rations to meet the wants of his particular case. The exercise will prove not only interesting, but profitable, for it will throw much light on the proper combinations of food to best meet the wants of our farm animals.

CONCLUSIONS IN REGARD TO THE GERMAN SYSTEM.

In presenting the German system I have followed it closely, so that the reader may be able to make practical use of it. About 1880 Prof. J. W. Sanborn objected to the feeding standards as laid down by the Germans, and especially to Table II., claiming that an ox weighing 1,000 pounds, when fed with the nutrients as stated by Wolff, as required for mere maintenance, might actually show considerable gain in weight. Results at Cornell University and other experiment stations in this country go to sustain Prof. Sanborn's objections. Inquiries sent out

from this station to successful, intelligent dairymen, bring information which shows that some are feeding rations which correspond very closely to the requirements laid down by Wolff, while others are giving less protein than in the siandard. Practical experience seems to show that good results may be obtained with less protein than $2\frac{1}{2}$ pounds per day per thousand pounds of cow. In many rations I think if the amount is 2 pounds it will be ample for the dairy cow. The total amount of digestible substance should not vary materially from the standard. These tables may be compared to a crude and often incorrect map of an unknown country, which is better than nothing, though far from satisfactory. It is well for the reader to familiarize himself with them, for their teachings are very helpful in the practical work of feeding.

PRACTICAL FEEDING—THE CALF.

In successful stock management we must start with a strong, vigorous calf. This means good blood in both sire and dam, and that there has been liberal feeding and good care for generations back. Where cattle are reared under practically natural conditions, the rule that young stock come in the spring must continue, but I am not so sure that spring is the best time for the dropping of calves in the older sections of the country. Spring calves are incapable of receiving much benefit from grass during the first season, because for some time after birth the ruminating stomach is undeveloped, and between summer heat and pestering flies the thin-skinned creature has a sorry time of it. Winter comes on with its dry food just when good progress has commenced, and this is apt to check growth, so that the animal is a full year old before it starts on its career untrammeled. Our experience at this station

corresponds with that of thousands of farmers who are strong advocates of having calves dropped in the fall. There is then much time to give them the little attentions needed, and since they live largely on milk they are easily managed in barn or shed, and occupy but little room. When spring comes the youngsters are large enough to make good use of the pasture, and the result is good progress from the start, and when fall comes they return to the barn large enough to make good use of the feed there provided. Cows fresh in the fall yield a good flow of milk during the winter, if well fed and comfortably housed; just when the milk flow begins to decrease materially comes the favorable change to grass, under the stimulus of which the milk flow is increased and held for some time. From our experience I put the annual yield of milk at from 10 to 15 per cent greater from cows fresh in fall than those which calve with the springing of the grass. Breeders of pedigreed cattle will find an equal advantage with dairymen, I think, with fall calves, for the six months gained make stock a year from the next spring of sufficient age to show up in fine style and practically command the prices of two-year-olds.

FEEDING THE CALF.

Where the calf is allowed to run with the dam few precautions are needed, the most important being to see that it does not get too much milk, which may cause indigestion. If the calf remains with the dam the cow's udder should be stripped out clean night and morning. Any neglect in this particular may result in soreness to the teats and udder. If the calf scours, the cow should be stripped three times a day; in other words, reduce the quantity of milk the calf gets. A young calf had better

be a little hungry than gorged. After two or three months separate the calf from the dam and allow it to suckle three times a day, afterwards twice. The greatest danger under this system comes at weaning time, when, if the calf has not been properly taught to eat solid food, it is apt to pine and shrink in weight, or at least make little gain. Teach the calf early to eat grain, using ground corn, bran, oil meal, and fine cut hay. The system of allowing calves to take the milk direct from the cow can only be practiced with the very best representatives of beef breeds, where the most rapid and perfect development is desired, either for making early matured beef or for developing fine pedigreed stock.

I believe no breed of cattle can be continued as a first-class dairy breed where the calves run with the cows. There is something about hand milking which causes a cow to give more milk and for a longer period than when it is drawn by the calf. Fine calves, even for beef purposes, can be made where the calves drink full milk from the pail, but the stockman will usually choose to have the calf do its own milking, or, if not, to subsist on skimmed or partly skimmed milk.

In dairy districts few calves are raised except on skim-milk, and very satisfactory dairy stock can be made by this process if a few simple rules are intelligently followed. The young calf should be taken away from the mother not later than the third day, and for two weeks given from 10 to 15 pounds of full milk, not less frequently than three times a day. At the end of two weeks some skim-milk may be substituted for a portion of the full milk, making the change gradually until in three or four weeks skim-milk only is fed. Full milk of the Jersey or Guern-

sey cow is often too rich for the calf, and part skimmed milk should be used from the very start. At the end of a month or six weeks the calf will do nicely on two feeds per day. Feeding Table I. shows that the cow's milk has a nutritive ratio of 1 to 3.7. In skim-milk the ratio is 1 to 2.1. Skim-milk contains all the elements of full milk excepting the fat, and we can in a measure make up for this with cheaper substitutes. Probably the best simple substitute is flaxseed, which should be boiled until reduced to a jelly, and a small quantity given at each feed stirred in the milk. Oil meal is cheaper than flaxseed, more easily obtained and serves practically the same purpose. Keep each calf tied by itself with a halter in comfortable quarters, with a rack in front for hay and a box for meal. For feed use either whole or ground oats, bran, oil meal, or a mixture of these. By the third week have a mixture containing the grain feed at hand, and as soon as the calf is through with the milk slip a little meal into its mouth. It soon learns the taste, and, following that instinct so strongly marked, takes kindly to the meal in the box, and in a few days eats with the regularity of an old animal. Have the meal boxes movable, and place the meal in them sparingly, emptying out all that remains before each feeding time. Change the kind or combination of grain if the calves seem to tire with what is given.

A prime requisite to success in calf feeding is regularity; let the calves be fed at the same time and in the same order each day. Next to regularity, regard the amount of milk fed. While 15 to 18 pounds of full milk is a ration, with skim-milk from 18 to 24 pounds may be fed, depending on the ability of the calf to assimilate its food. More skim-milk calves are killed by overfeeding

than underfeeding. Milk should be fed at blood temperature, say 98° to 100° F., and a thermometer should be used in ascertaining the temperature. The feeding pail should be kept scrupulously clean by scalding once a day, a precaution often neglected.

Scouring, the bane of calf rearing, usually indicates indigestion, and is brought on by overfeeding, irregular feeding, giving the feed too cold, or the animal getting chilled or wet. Prevention of disease by rational feeding and systematic good care is far better than poor care and unskillful feeding, followed by attention and solicitude in giving medicines. To check indigestion we have found the use of a tablespoonful of limewater in each feed very satisfactory. Successful management of the calf lies at the very foundation of the stock business, and calls for regularity of attendance, discerning at once all the little wants of the animal, and a generous disposition to supply every need as soon as apparent.

FEED AND CARE OF YOUNG STOCK.

With well-bred calves, thrifty and sleek coated, the foundation of a good herd is laid. Though the subject will be discussed more fully later on, it is well to remind the reader at this point that gain is never so cheaply made as with the calf, and that for financial reasons if no other it should be pushed ahead as rapidly as possible. Our table of feeding stuffs shows that milk contains a large amount of protein or muscle-making food, and it also contains a large amount of ash for building up bone. From the composition of milk, nature's food for the young animal, we get a hint at the formation of rations for young animals. Pasture grass has a nutritive ratio by the table of 1:4.9, so that it is also high in muscle elements. But

nature put a large amount of fat in cow's milk, and calves reared on full milk show a very considerable development of fat. They should not grow poorer after weaning time, but the first fat, as the stockman calls it, should be kept on all representatives of the beef breeds, whether intended for breeding purposes or for beef. This can be accomplished with oil meal and corn; a little oats will do no harm. Counteract the tendency of the grain foods to making a rigid dry flesh, by using roots or silage, which, combined with grain, make the animal growthy while keeping it plenty fat. For roughage use cornstalks, clover or alfalfa hay. The dairy calf should never be allowed to become as fat as those intended for beef, yet this does not mean that it should be the sorry representative that we often find it. Very little corn should be used in its ration and the proportion of oil meal stinted, while oats should form a larger part of the ration. This, with silage or roots and plenty of roughage in winter and pasture in summer, will give animals of the desired quality. Calves, like colts, pass through a period of growth when they are not particularly attractive, nor do they need very close attention at this time; yet the watchful eye of the master should note the development from day to day and see that all the wants are fully supplied.

STEER FEEDING—PASTURES.

There are two theories in regard to the proper time of turning steers to pasture, each of which seems based on good reasons. That generally advocated by agricultural writers is to keep the stock in the barn and yard on the same food as given during the winter months until the pastures are well along and able to furnish an abundadce of nutritious grass. Often when stock are turned on such

pastures the ration of the feeding stable is cut off at once. The other system is to turn to pasture just as the grass begins to shoot, when the sparse blades are watery and furnish very little nutriment. The lack of food in the pasture forces the stock to rely mainly on what is obtained in the stable to satisfy hunger. The first grass is washy and has little nutriment, but has its effect on the digestive system, and gradually prepares the animal for the change from grain to pasture. It is a fact that stock often shrink badly when changed from stable to pasture, and I suspect the practice of early turning to grass, at the same time keeping up heavy stable feeding, is better than holding the cattle longer and then turning at once to full pastures. If stock is turned to pasture early, and in any event, let food in abundance be offered them at the stable. It is troublesome to bring them back to the barn each night, yet it is little attentions like these that pay.

The question of large or small pastures is one frequently discussed. I believe the majority of experienced American feeders are in favor of single ranges rather than numerous small pasture lots. The grasses, both in variety and quality, are never quite the same all over a large pasture, and cattle soon learn to detect the little differences and satisfy their like for variety by ranging from one sort of feed to the other. The habit of the herd in large pastures becomes very regular; they will be found in the morning on this side of the valley, a little later over on the hillside, while at noon they are resting at still a third point. Continuity of habit in grazing and feeding conduces to comfort and quiet, and are of great importance to profitable returns. Where the pastures are cut up into several lots of course the fresh bite which comes with

changing from one lot to another is tempting, but this leads to irregularity and unrest.

GAINS OF STEERS ON PASTURE.

Prof. Morrow, of the Illinois Experiment Station, has made some interesting studies on this point. He reports the gain per head of steers maintained wholly on pasture during the season from May 1 to November 1 to be as follows:

Yearlings.

	Pounds.
4 head of steers showed an average gain of	332
10 head of steers showed an average gain of	285
2 head of steers showed an average gain of	440

Two-year-olds.

	Pounds.
7 head of steers showed an average gain of	466
8 head of steers showed an average gain of	384
4 head of steers showed an average gain of	406

I think these figures are very satisfactory, and probably up to the average which can be attained on good pastures by grade steers in fair flesh when turned to pasture. No doubt animals in thin flesh when turned to pasture will show larger gains. An interesting phase of the same question is the amount of gain made by steers from an acre of pasture land. In different trials Prof. Morrow obtained returns of 246, 206 and 138 pounds of increase live weight per acre from steers on pasture. The average of these gains shows that when beef brings a reasonable price such pastures have a value of something like $100 per acre.

FEEDING GRAIN TO STEERS ON PASTURE.

J. D. Gillett, Illinois' great stock-feeder of the last generation, used to say that he could not afford to fatten

steers in winter. His cattle were mostly summer and fall fed, getting their grain from boxes in the pasture fields. Unfortunately we have little accurate data at command to show the value of grain feeding on pastures. Prof. Morrow has made several trials, but the results so far do not seem to confirm the statements of Gillett and others. Prof. Morrow sums up the experience at the Illinois Station as follows:

> The results from two years' trial indicate that a grain ration to young steers on good pasture is not usually profitable. The value of the increase in weight by the grain-fed steers over those having grass only will hardly repay the cost of food and labor. The increased value of the animals from earlier maturity and better quality may make grain feeding profitable.

While his results to date do not show very favorably for grain feeding on good pasture not overstocked, he strongly advocates the addition of grain or other feed before grass fails in the fall.

INDIAN CORN FOR STEER FEEDING.

Corn is the great fattening food of America, and no other grain is so cheaply raised or equals it in the economical production of wholesome meat. Our stockmen long ago learned this fact, and have used corn so exclusively that not always the most economical results have been obtained. With the almost continual plethora of grain careless habits have been acquired in handling the crop, some of which will cost much to unlearn. The roughage of the corn crop, the stalk portion, has been largely wasted through ignorance of its real value and how it should be fed to stock. Dr. Armsby has made some very careful studies of the corn plant, and some of his results are given in Tables IV. and V. Table IV. shows

the proportion of ears to stover. By stover is meant all of the dried corn plant less the ear, or practically shock corn with the ears removed.

TABLE IV.—*Showing the actual weights of ear corn and stover at four experiment stations.*

Name of experiment station.	Ears.	Stover.
	Pounds.	*Pounds.*
New Jersey	4,774	4,041
Connecticut	4,216	4,360
Wisconsin	4,941	4,490
Pennsylvania	3,727	2,460
Average	4,415	3,838

We see that nearly half of the weight of a corn crop is in the stalk, husk, leaf and top. In Table V. is given the digestible portions of the ear and stover.

TABLE V.—*Showing the yield of digestible matter in pounds per acre.*

Constituents.	Ears.	Stover.	Total crop.
	Pounds.	*Pounds.*	*Pounds.*
Protein (including amides)	244	83	327
Carbohydrates	2,301	1,473	3,774
Fat	125	22	147
Total	2,670	1,578	4,248

This table shows that of the digestible matter in an acre of corn 2,670 pounds are in the ears and 1,578 pounds are in the stover or cornstalks. On many farms the stover is almost wholly wasted, or at least but poorly saved and carelessly fed. Can the farmers of the Mississippi valley much longer afford to waste 37 per cent of this great crop after they have gone to the expense of producing it? Of course I do not hold that all the cornstalks produced in a corn crop can be fed to fattening steers, for this would mean the consumption of too much roughage in proportion to grain. But there are always on the farm horses, cows,

and young things that can well be maintained on the surplus stover of the corn crop. That farm which cannot utilize all of the cornstalks produced should change its management.

I do not think the heavy corn-feeding commonly practiced at the West nearly so wasteful as many have thought. The corn is fed with a prodigal hand, but this does not necessarily mean a heavy loss when the cost of material and the economical conditions under which it is often fed are all duly considered. But now that the price of beef is lower and the price of land and corn rising, it is time for a careful study of the problem in order to save as much as possible. Corn may be fed to a steer as the only grain for a couple of months, with excellent returns, even without grinding or shelling, providing the grain is not too hard or the ears too large and good shotes follow the steers to utilize the waste corn in the droppings. But steers cannot be fully fattened on corn alone with profit, for the concentrated grain soon burns out the digestive tract and the steer comes to make poor use of his food. Whole corn may be fed early in the period, but generally, and always later on, it should be crushed or ground into meal. I think crushed corn or coarsely ground meal will be found preferable to that which is finely ground. In all cases where much meal is fed care is needed lest the animal get off feed. Some oil meal or bran should be fed to lighten the ration, starting with 1 pound of oil meal and gradually increasing the amount until, toward the close of the period, as much as 5 pounds may be fed. In the same manner from 2 to 8 pounds of bran may be fed. The effect of oil meal is to give good handling qualities and a fine, glossy coat of hair, besides affording much

real nutriment. Bran is likewise cooling and lightens the heavy corn very materially. Roots or silage have much the same effect. I know objections will be raised that if all feeders were to use oil meal there would not be enough to go round; but why be solicitous when in 1890 we shipped $8,000,000 worth of oil meal to the feeders of the Old World?

With the grain there must always be fed coarse feeds in order to properly distend the rumen, and nothing is better for this purpose than good corn stover. Most stockmen know how satisfactory shocked corn is for steers. That portion of the stover not needed for the steers should be given to other farm stock.

BALANCED RATIONS.

In order to show what sort of a ration a steer should receive if fed according to the German standard, two rations are here presented which conform fairly near to the requirements. The first is one which may well be used in the corn belt where corn is cheap and oil meal close at hand. The second presents more variety, and has silage and cotton-seed meal for two of its constituents.

TABLE VI.—*Showing rations for fattening steers.*

RATION NO. I.

Character of rations.	Organic matter.	Digestible—		
		Protein.	Carbohydrates.	Ether extract.
Required by standard	27.0	2.50	15.00	.50
Corn fodder, 8 pounds	4.41	.22	2.36	.08
Clover hay, 2 pounds	1.57	.13	.70	.03
Corn (maize), 14 pounds	12.31	.98	8.88	.55
Oil meal, o. p., 4 pounds	3 41	1.13	1.29	.28
Total	21.60	2.46	13.23	.94

TABLE VI.—*Showing rations for fattening steers.*—Continued.

RATION NO. II.

Character of rations.	Organic matter.	Digestible— Protein.	Carbohydrates	Ether extract.
Corn silage, 30 pounds	5.85	.36	3.54	.18
Oat straw, 5 pounds	4.29	.08	2.09	.04
Roller bran, 10 pounds	8.24	1.26	4.41	.29
Corn and cob meal, 4 pounds	3.34	.26	2.25	.12
Cotton seed meal, 2 pounds	1.69	.74	.36	.25
Total	23.41	2.70	12.65	.88

In both tables there is less organic matter than called for by the standard, but this is not important. The carbohydrates are less than the standard, but this lack is nearly made up by the excess of ether extract or fat.

SILAGE FOR STEER FEEDING.

The British farmer leads the world in the perfection of farm stock, and while this may not be altogether due to his system of feeding, yet that must be a large factor. Under the English system farm animals do not go for any long period on dry food. The cattle go to pasture early and remain late, and when in the stable or yard still have succulent feed in the shape of roots. How different the American system, where our cattle are on pasture a few months in summer and then return to the stable and yard to subsist on dry food of limited variety for nearly six months! It may not pay in many cases for farmers to grow roots for stock, but we have a means of providing a cheap substitute for turnips and mangolds in corn silage. I do not at this time wish to discuss the relative merits of silage and roots, but rather to plead for more general introduction of the silo with those farmers who do not take kindly to root culture. The wonderful development

of machinery for planting and cultivating corn enables the farmer to produce a large amount of excellent feed with very little labor. If by some means the juicy, tender stalks can be carried over to winter we have a very fair substitute in cheap form for the root crop, and this is accomplished by the silo, which gives us at a very small cost a succulent food, palatable to horses, cattle and sheep.

The use of silage came through dairymen, and to this day the steer-feeder seems to hold that silage is only suitable for dairy cows and too sloppy and sour for beef-making. Gradually the prejudice is breaking away and beef-makers as well as butter-makers are beginning to appreciate the silo.

SILAGE COMPARED WITH ROOTS FOR STEER-FEEDING.

The great silage material is Indian corn. In the corn belt from 10 to 20 tons of green fodder may be raised on an acre of fertile land. If we put the average crop at 15 tons as it goes into the silo, it will feed out 12 or 13 tons. When corn is planted to yield the material above stated the stalks stand thin enough to produce a good many ears, or nubbins. To show the value of corn silage for steer feeding I present the results just published by Prof. Shaw, of the Ontario Agricultural college, where six grade Shorthorn steers were fed in three groups of two each.

To Group I. was fed all the steers would eat of corn silage, with about 12 pounds of corn meal.

To Group II. were fed 30 pounds of silage per day, about 12 of meal, and all the cut hay the steers would eat.

To Group III. were fed 45 pounds of sliced roots, and

about 12 pounds of meal, with all the cut hay they would eat.

The hay was timothy and clover, the roots turnips and mangolds, and the meal consisted of equal weights of ground pease, barley and oats. The hay was chaffed and the food mixed at the time of feeding and given in three feeds per day.

The food actually consumed per animal per day was as follows :

Group I	57.47 pounds silage. 11.72 pounds meal.
Group II	30.6 pounds silage. 11.13 pounds meal. 9.3 pounds hay.
Group III	43.07 pounds roots. 11.12 pounds meal. 11.22 pounds hay.

The following table shows the results of the trial, beginning December 1, 1890, and lasting 146 days:

TABLE VII.—*Showing results of steer-feeding trials at Ontario Agricultural College.*

	Group I (2 steers)	Group II (2 steers.)	Group III. (2 steers.)
	Pounds.	*Pounds.*	*Pounds.*
Weight at commencement	2,789 00	2,735.00	2,672.00
Gain of two steers 146 days	555.00	448.00	537.00
Average gain per steer	277.00	224.00	268.00
Average gain per steer per day	1.90	1.53	1.84

Prof. Shaw places the following value on the feeds:

Oats	24½ cents per bushel.
Peas	47 cents per bushel.
Barley	38 cents per bushel.
Sliced roots	8 cents per bushel.
Cut hay	$5.00 per ton.
Corn silage	1.75 per ton.

Six cents per bushel allowed for grinding grain.

The financial results are presented in the following table:

TABLE VIII.—*Showing financial results.*

Value of animals and cost of feed.	Group I.	Group II.	Group III.
Value of two steers in beginning	$111.56	$109.40	$106.88
Cost of feed	42.92	41.45	51.75
Cost of attendance	6.08	6.08	6.08
Value of animal at close of test	183.93	175.10	176.53
Value of manure	13.14	13.14	13.14
Total value	197.07	188.24	189.67
Gain	36.51	31.31	24.96
Per cent gain on investment	22.70	20.00	15.20

At the commencement the steers were valued at 4 cents per pound, live weight, and were worth 5½ cents per pound at the close. It will be seen that the heaviest gain per day was made by the steers receiving silage, and further that they returned the best per cent on the investment; the root-fed steers gave the poorest returns of the three groups.

At this station we have fed silage to steers with most excellent results. In one trial four 2 and 3-year-old steers were fed corn silage alone and made a gain of 222 pounds in thirty-six days, or 1½ pounds per day. It required 3,558 pounds of silage to make 100 pounds of gain. Four steers from the same lot were fed silage with a mixture of corn and bran, when it was found that 654 pounds of corn silage with 394 pounds of corn and 180 of bran produced 100 pounds of gain. Four shotes running with the steers were fed only 92 pounds of corn to make a gain of 100 pounds, showing that they must have received most of their food from the droppings. Let the feeder place any reasonable value he may choose on the silage in these two trials and he will see that we produced 100 pounds of gain at a very small cost. The objection to

our experiment is that the steers were only fed silage forty-three days, the first week not being counted, but further feeding with a heavy grain ration and hay showed that the gains from the silage were well held when the animals were placed on dry feed.

This brings me to the point I desire to make in favor of silage for steer feeding. As with roots, silage makes the carcass watery and soft to the touch. Some have considered this a disadvantage, but is it not a desirable condition in the fattening steer? Corn and roughage produce a hard, dry carcass, and corn burns out the digestive tract in the shortest possible time. With silage and roots digestion certainly must be more nearly normal and its profitable action longer continued. The tissues of the body are juicy and the whole system must be in just that condition which permits rapid fattening. While believing in a large use of silage in the preliminary stages and its continuance during most of the fattening period, I would recommend that gradually more dry food be substituted as the period advances, in order that the flesh may become more solid. Used in this way I believe silage will become an important aid in steer feeding in many sections of the country. Results from Canada, Wisconsin and Texas, given in this chapter, show the broad adaptation of this food for stock-feeding purposes.

BEEF-MAKING AT THE SOUTH.

Few realize the possibilities of beef production over a large portion of the South. For centuries the study there has been toward cotton production, which demands scrupulously clean culture; grass has been despised and considered a pest, but now it has overrun some of the old plantations, and while restoring the soil to something like

its former fertility, is giving good annual yields of nutritious food for cattle. Many a cotton plantation can be made to return in Bermuda grass, Johnson grass, or Japan clover an amount of feed that would surprise even a northern stockman. Equally important with the growth of grasses is the enormous production of cotton seed, which furnishes a most nutritious feed. For every pound of cotton fiber there are about 2 pounds of cotton seed. A ton of cotton seed yields about 35 gallons of oil and 750 pounds of cotton-seed meal, besides nearly a thousand pounds of cotton-seed hulls. The cotton seed itself, when boiled, and the cotton-seed meal are valuable stock foods, and recently even the hulls have been found to possess considerable feeding value, proving a very good substitute for hay. The following table shows results obtained by Prof. Gulley in feeding cotton-seed meal at the experiment station :

TABLE IX.—*Showing feed consumed for 100 pounds gain in weight at the Texas Experiment Station.*

No. of steers.	Days of experiment.	Average weight at beginning.	Cotton seed, raw.	Cotton seed, cooked.	Cotton-seed hulls.	Cotton meal.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
6	90	755	....	417	....	....
4	90	737	....	....	....	217
3	90	780	....	....	561	228
4	90	713	....	....	759	259
4	90	785	....	....	724	178
8	90	725	....	....	579	247
10	79	671	....	....	385	154
9	79	662	194	....	....	....
3	79	636	....	147	....	....

TABLE IX.—*Showing feed consumed for 100 pounds gain in weight at the Texas Experiment Station.*—Continued.

No. of steers.	Corn in ear.	Corn and cob meal.	Silage.	Hay.	Cost per 100 pounds gain.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	
6	....	....	1,230	218	$2.70
4	....	....	1,676	....	3.83
3	....	....	595	....	3.71
4	....	....	....	....	3.72
4	....	212	....	....	4.09
8	....	....	....	264	4.13
10	....	....	630	....	2.72
9	219	....	411	167	2.67
3	519	....	....	254	3.86

The values placed on the food articles in this table are as follows:

Cotton seed, raw or cooked ....per ton..$7.00
Cotton-seed hulls ....do.... 3.00
Cotton-seed meal ....do....20.00
Corn and cob meal..............per bushel.. .40
Mixed hay....... ....per ton.. 6.00

These gains are very satisfactory, and I doubt if in any other section of the United States a pound of beef can be produced at so low a cost for food as is here given.

FOOD REQUIRED FOR MAKING A POUND OF BEEF.

Our experiment stations are helping in the matter of determining the amount of food required to produce a pound of beef, and the results are proving most interesting reading. In the following table is summarized the amount of food required to produce 100 pounds of gain, live weight, with calves and steers at different ages. It will bear careful study.

TABLE X.—*Food required for 100 pounds of gain, and daily gain in weight, with calves and steers, at different ages.*

No. of animals on experiment.	Breed.	Average age at beginning of experiment.	Length of experiment.	Average weight at beginning of experiment.	Food required for 100 pounds of gain. Whole milk.	Skim'd milk.	Grain feed.	Hay.	Silage.	Roots.	Green feed.	Average daily increase.
	WISCONSIN EXPERIMENT.											
		Days.	*Days.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
6	4 Jersey, 2 Holstein.	46	84	152	....	477.1	90.9	81.2	....	....	....	1.75
6	........do........	130	63	299	....	422.6	226.0	62.2	218.7	....	....	1.75
	ONTARIO A. C. EXPERIMENT.											
7	6 different breeds, 1 native	15	182	‡190	971.6	....	48.5	31.7	....	....	20.2	2.15
7	....do....	195	183	482	....	....	475.1	239.2	....	479.8	179.5	1.84
1	Shorthorn	*7	182	‡182	1262.0	....	50.5	47.2	....	....	57.0	2.04
1	....do....	189	183	454	....	....	419.3	268.7	....	827.5	....	2.15
	MICHIGAN EXPERIMENT.											
10	6 different breeds	105	260	244.2	....	....	236.0	236.3	7.0	....	....	1.79
10	....do....	365	365	709.4	....	....	555.9	667.4	128.8	78.8	....	1.37
10	....do....	730	358	1208.8	....	....	826.4	613.1	186.6	196.5	....	1.07
8	5 different breeds	322	184	693.8	....	....	375.8	272.1	(†)	162.2	....	1.16
8	....do....	506	181	917.2	....	....	523.1	342.2	314.7	347.3	....	1.90
8	....do....	687	179	1260.8	....	....	749.2	322.5	719.9	7.1	....	1.57

* "Less than nine days old."
† Pasture.
‡ Assumed.

The table shows results obtained at the Wisconsin station with skim-milk fed to Jersey and Holstein calves. At the Ontario College calves representing six different breeds were fed on full milk at first, the trial lasting a year. The Michigan experiments are the most complete, and cover three trials with two lots of steers representing six different breeds in the first trial and five in the last. In the Wisconsin experiments the grain consisted of oats, bran and oil meal. At Michigan it was wheat bran, oats, corn, and some oil meal. At the Ontario College peas, oats, wheat screenings, bran and oil cake were fed.

INCREASED FOOD REQUIRED WITH INCREASED WEIGHT.

I ask the reader to carefully review the results obtained at the Michigan station, and note the steady increase in the amount of food required to produce 100 pounds of gain. With so many animals on trial, representing different breeds and long feeding periods, these results cannot be accidental, but must represent some rule of nature of great importance to the feeder. As we have learned from the second table in this chapter, an animal requires a very considerable amount of food for mere maintenance of the body, so that, as the body weight increases, more and more feed must be given for its mere maintenance, and only from the excess which the animal may consume comes the increased weight. At first the young animal is able to eat and digest much more than is required for its maintenance, and out of the large excess a rapid increase in weight results. Though the total amount of food consumed increases very considerably with the age of the animal, yet gradually the amount required creeps up until finally all is required for mere maintenance

of the body, and there is no gain in weight for profit to the feeder.

EARLY MATURITY A NECESSITY.

The facts just noted lead to the last suggestion in regard to steer-feeding. Some of my readers will recall a period when it was not considered well to fatten a steer until he was 5 years old. A much larger number will recall the early exhibits of cattle at the Chicago Fat Stock Show, where prizes were offered for big steers. The long-legged, raw-boned creatures that competed for premiums in those days are now almost a thing of the past, but there is still room for large improvement. Early maturity has worked wonders in pork-making, and is more slowly but surely accomplishing equally striking results with beef cattle. While in parts of the Old World hogs are not fattened until 2 or 3 years old, on thousands of American farms in the corn belt April-born pigs are started for Chicago in November. Prices are now so low for beef that cattle must be quickly turned and every pound of food made to do its utmost. What can be accomplished in the way of early maturity is illustrated by results obtained by Mr. W. A. Harris, of Linwood, Kansas, who reports, in the Breeders' Gazette, his experience with "baby" beef. He feeds pure-bred and grade Shorthorn calves coming in December, January and February until the following December, when they average 11 months old. These calves generally had most of their dams' milk until 6 or 7 months old, and Mr. Harris figures that they each consumed:

20 bushels of corn, worth	$5.00
1,000 pounds bran, worth	6.00
300 pounds oil meal, worth	3.00
Total cost of grain	14.00

In addition they had pasture and what hay they would eat, which, together, he estimates at $4. These calves weighed from 910 to 920 pounds each at eleven months, and brought from $3.80 to $5.00 per hundred, which returns are certainly satisfactory, while yearlings have but held their own and required the space and feed of nearly two calves during the additional twelve months, to say nothing of interest and accidents. While Mr. Harris' figures doubtless represent the extreme limit in the direction of early maturity, and it is probable that many will not dare to attempt to sell beef at twelve months old, there is no good argument for not making a vigorous effort to steadily reduce the age at which steers are marketed. The first requisite is good breeding, for without a good calf further effort is of little avail. There is a gross error abroad which it seems almost impossible to down, and that is the idea that blooded stock can live on less food than the common cattle of the country. The truth is that such animals, being more artificial, really require better care and more abundant food. Their point of vantage is their ability to consume a large amount of food, making the most of it and putting it on the most valuable parts of the body in the shape of meat; further, they do this at an early age, long before native cattle have reached anything like maturity. Improved stock means an improved feeder with an intelligent understanding and good corn cribs. Having good stock, feed liberally. I know of no greater crime toward our stock in this country

than parsimonious feeding. It is even more common to hear men boast of how little their cattle have wintered on than how much they have been fed and what large gains they have made. There must be a great change in this particular before genuine improvement comes.

THE DAIRY COW—INTRODUCTORY.

Enormous as is the dairy industry of this country, its continued growth for some time yet seems almost certain, for the reason that our progress has been largely in the direction of an improved product rather than a mere increase in gross output. Low prices for beef cattle have been brought on in no small measure through flooding the market with lean or half-fatted steers, which must be consumed in some way and drag down the prices of well-fatted representatives of their kind. The spread of the creamery system does not necessarily mean that more cows are used in the production of butter, but rather that more butter of a uniformly high quality is being made to take the place of dairy butter, much of which has a doubtful reputation. Increased consumption naturally follows improvement in quality, and with more good butter on the market more is consumed, and for this reason more than any other I think the prices of dairy products have held up so well in the past.

But dairying will continue for another reason, which lies at the foundation of stock-feeding, and this is because the cow gives a larger return for her food than does the steer. I doubt if many of my readers have ever reflected upon just this phase of the question, but it is one of large importance and will some day be carefully studied.

In Table III. we have given the ration of a dairy cow weighing 1,000 pounds, as follows:

	Pounds.
Corn fodder	14
Clover hay	6
Bran	5
Corn meal	5
Cotton-seed meal	2

From this ration we may suppose a good dairy cow will yield about 25 pounds of average milk. Supposing we feed the same ration to a steer weighing 1,000 pounds. I am sure the majority of feeders will agree that 2 pounds of increase, live weight, will be a fair return for this amount of food. Lawes and Gilbert, of England, made careful analyses of the carcasses of ninety-eight oxen to determine the character of their increase while fattening, which they found to be as follows:

	Per cent.
Ash	1.47
Protein (dry lean meat)	7.69
Fat	66.2
Water	24.6

Let us place the food constituents of a day's increase of 2 pounds live weight of the fattening steer beside what is contained in 25 pounds of average cow's milk:

TABLE XI.—*Showing the returns from a dairy cow and a fattening steer for one day.*

Constituents.	Returns from— Twenty-five pounds cow's milk.	Two pounds increase in steer.
	Per cent.	*Per cent.*
Ash	0.17	0.03
Protein	0.90	0.15
Fat	0.90	1.30
Sugar	1.20	0.00
Total	3.17	1.48

Our dairy cow has given nearly six times as much ash, six times as much protein, and 70 per cent as much fat as is returned by the steer, with 1.2 pounds of milk sugar, against which the steer has nothing to show. If we reduce this milk sugar to its fat equivalent by dividing by 2.2 we find the milk sugar given by the cow to be worth for food purposes 0.56 of a pound of fat. All of the constituents of the milk are digestible and furnish the best of human food, while much of the increase of the steer is hardly available for food as we commonly use meat. At the present time, when coarse feeds and grains are raised in such enormous quantities in America, we are more or less indifferent to the relative economy of the cow and steer in condensing gross hay and the coarse grains into human food, but when population becomes great the steer must give way before the cow in the contest of economically producing food for men.

THE ART OF DAIRYING BASED ON THE MATERNITY OF THE COW.

Nature's purpose in storing fat beneath the skin and between the muscular tissues of the animal body is to lay up heat and energy material against the time of need. This process goes on rapidly at first, but after a time the system seems gorged, and further storage is secured at a high cost for feed. How different with the dairy cow. Food given at night, for instance, is digested and elaborated into milk ready for the calf in the morning, and is at once disposed of instead of being stored up and added to the body to be utilized and carried about, and it is for this reason, probably, that the cow surpasses the steer in the economical manufacture of human food.

It is the appropriation by man of food material in-

tended for the calf that makes possible the great art of dairying. Under the stimulus of good feed and long selection our dairy cow produces much more milk than is needed for the calf, and has become more or less an artificial creature.

The basis of the whole dairy system is the maternity of the cow, and the successful management of a dairy depends upon fully comprehending and intelligently following out this idea. To ex-Governor W. D. Hoard, of Wisconsin, belongs much credit for bringing this view to the attention of our dairymen, and the effort has been of untold value, for no one can fairly consider the problem as thus stated without regarding the dairy cow in a new light.

SHELTER.

I have spoken favorably of open sheds for steer feeding, urging that with his load of fat and stomach filled with heating grain this creature has a better appetite and is more comfortable with the freedom of such quarters than in the average stable. For reasons just shown our dairy cow is under very different conditions and shrinks from cold and exposure. Any other animal on the farm will stand more exposure without suffering than a cow giving a large flow of milk.

Close confinement in the barn during the whole winter is a subject now being much discussed by dairymen, and some argue for the practice, reporting favorable results. I cannot believe that it is well to keep cows confined for four or five months in one spot. The dread disease tuberculosis has already found a lodgment in too many herds scattered over the country, and its spread is something greatly to be feared. It is not unreasonable

to hold that dairy stock confined generation after generation in the stable, out of the sunlight and fresh air, for many months each year, must, after a time, become more susceptible to this disease than where more freedom is allowed.

PROF. ROBERTS' SYSTEM.

It is not well to turn stock out into the bleak winter storm to obtain fresh air and exercise, but can we not modify our present system so that the cows shall have the freedom and avoid the exposure? At Cornell University Prof. Roberts has for years followed a plan which seems of great value in its teachings to the dairymen of this country. The cows stand in stanchions while feeding and being milked, but immediately afterward they are turned into a large covered yard, where they are free to stand or lie, entirely unconfined except by the walls, so that they have a dining room and living room, each adapted to its purpose. The accumulations from the horse stable are spread over the floor of the covered yard where the cows spend most of their time, and is covered with straw and land plaster, used to prevent odors arising. This perfect system of saving manure should alone pay in a few years for the cost of the additional room required. The stable can be reduced to the smallest size compatible with holding the cows and permitting milking and feeding, and can be kept scrupulously clean and thoroughly aired, since the cows are in it but a few hours each day. Under these conditions the cows should come to their meals each day with the best of appetites and return to their larger quarters to ruminate in comfort. Where dairymen are buying and selling cows constantly, using each animal but a few years, close confinement and little attention to the health

of the herd may not bring unfortunate results, but there are many persons breeding choice herds of dairy animals who wish to take as little risk as possible from weak constitutions or inducing tuberculosis. To such I commend a careful review of the Cornell system.

REGULARITY AND KINDNESS IN THE DAIRY.

The dairy cow is the creature of habits, as well as most other animals, and is very susceptible to favorable or unfavorable influences. At this Station a record of every milking is kept, and in looking over it we can tell when Sunday comes by the smaller yield on that day. Our men milk a little later Sunday morning and a little earlier at night, probably hurrying the operation, and the cows resent the treatment by a somewhat smaller yield of milk. Dr. Babcock has found that a new milker will get less milk from a cow at first than the milker to which she is accustomed. Milking the teats in a different order also affects the percentage of fat in the milk and the amount of milk given. Irregularity in the order of feeding must also have an unfavorable effect.

Probably a very considerable portion of the milk is elaborated by the cow during the time of milking, and if this is true it is not difficult to understand that the cow should be in perfect comfort of mind and body during this time. The dairyman should follow a regular system in his feeding operations, supplying the same kinds of food at the same time in the day and in the same order. Milking should be performed with regularity, the cows being milked in the same order and so far as possible by the same milkers.

RECORDING AND ANALYZING MILK.

We have found nothing more helpful for its cost than the use of scales in the dairy barn for recording the milk yield of each cow at each milking. A sheet of manila paper can be quickly ruled with a lead pencil and the names of the cows placed at the head, with the days of the week along the side of the sheet. These sheets can be made to hold either a week's or a month's record, the former being preferable, we think. A pair of spring balances, tested occasionally, prove very satisfactory for weighing the milk. The fraction of a minute is all the time required for the milker to get the weight and enter it upon the record sheet. The effect is most salutary and conduces to better milking and more kindly care for the cows, since each milker is desirous of making a good record.

The fat contained in the milk practically measures its market value, and the milk of different cows varies so in the fat content that the dairyman really knows very little of what his cows are doing when he goes no farther than weighing the milk. Churn tests to learn how much butter a cow can make have been recommended, but to set the milk of each cow separately and churn it carefully involves so much labor that this system is hardly practical. In the Babcock test the dairymen now have a simple, rapid and inexpensive means of determining just how much fat there is in the milk of each cow in the herd. The dairyman who will use this test will be surprised at what it reveals. Some cows that were supposed to be among the best are found to yield milk poor in butter fat; while others, giving less quantity, may be leaders in the total amount of fat produced. With the scales to show

how much milk the cow gives during the year, and the Babcock test for analyzing the milk and determining the percentage of fat from time to time, the dairyman is in position to know just what his herd is doing, and can dispose of unprofitable animals and keep the good ones and their progeny. At least he has a means of measuring the true worth of each cow in the herd, and there is no longer any excuse for keeping and feeding unprofitable animals.

THE QUALITY OF MILK A RESULT OF BREED RATHER THAN OF FEED.

The opinion generally prevails among dairymen that the quality of milk is directly due to the feed supplied, most of them holding that certain feeds will make milk rich in fat, while other feeds will make it watery and thin. The results of carefully conducted trials in order to study the effects of feed on the quality of milk have generally shown that the composition is quite regular and little modified by the feed, though the total yield of milk of course varies greatly with the feed. I think in this particular case popular opinion is largely in error. With certain kinds of feeds the dairyman does increase the amount of butter he receives, but it is because the total amount of milk has been increased and not because a higher per cent of fat has been put into the milk.

And when we give the matter due thought the position here advanced seems the tenable one. We do not expect a fruit tree to change its variety of fruit through good or poor feeding. A Baldwin apple tree always produces Baldwin apples, though the number may be increased or diminished by the treatment of the tree. If feed were the controlling factor, the strong characteristics of the dairy breeds would all disappear with the art of the

feeder. Is it not more reasonable to hold that we must breed for quality and feed for quantity?

PREPARATIONS OF FOODS AND METHODS OF FEEDING.

We know that a horse standing idle in the stable in winter will live on oat straw and a little grain and keep in very fair condition. His digestive powers are untaxed and utilize the coarse material without difficulty, but as soon as the hard work of spring comes on he not only needs a good deal more feed, but, if very hard worked, the hay should be chaffed and the grain ground. The labor he performs has made such demands upon the body that there is not energy enough left to work over the coarse food and get enough out of it to make up the increased wastes of the body. We should always remember that our dairy cow is really performing a very large amount of work when giving a large flow of milk, and her food should not only be in large quantity but put in the best form possible for easy digestion. Even with an abundance of food carefully prepared, so strong are the inherent tendencies toward milk-giving that many cows will take from their own bodies a large amount of fat stored there and put it into the milk. If we will only come to regard our good dairy cows as working very hard while giving milk we are in position to treat them properly.

THE FEED-CUTTER.

There should be a good feed-cutter on every dairy farm, useful for silo filling in the fall and for chaffing feed in the winter. All cornstalks should be put through this machine, for then they are in better condition for feeding, and the coarser portions left uneaten are in good form for bedding and the manure heap. Long cornstalks are a

nuisance in a feeding manger, worthless for bedding and troublesome in the manure pile. Many farmers find difficulty in feeding cut cornstalks, since sometimes the cows refuse to eat them. In a few cases we have found that the sharp ends of the cornstalks, when cut certain lengths, injure the mouths of the cows. This difficulty can usually be avoided by changing the length of cut. Judging from experiments at the Kansas station, it is possible that in the lower portions of the corn belt cornstalks are so coarse and poor that they are not useful for feeding dairy cows, but farther north I am sure they will pay for the cutting. Where they are not well eaten the cause is often due to overfeeding, or endeavoring to have the cows live on too limited a variety of foods. Keep the mangers clean and feed the cut fodder with care, and usually very little will be left over, and that only the coarsest portion. Experiments at the Wisconsin station show that with the varieties of corn raised there much more of the cut stalks will be eaten than if fed uncut under the same conditions.

Where corn is cheap and labor high, uncut shock corn of small varieties can be very successfully fed to dairy cows. It is surprising to see how they thrive on it, and the undigested grain can be gathered from the droppings by lively shotes. This system is somewhat crude, but not without advantages in the pioneer stage of dairying in the corn belt, where it helps to educate the farmers to a proper appreciation of the value of corn and corn stover for dairy cows. After a time this practice should give way to more improved methods commonly followed in the older dairy sections.

Much has been written in regard to wetting hay, straw and stalks, putting meal thereon and mixing up be-

fore feeding. The English are accustomed to pulp or slice roots, mix these with cut hay or "chaff," as they call it, and then sprinkle the meal over the mass, shoveling it over. Such mixtures must be very palatable to the cow, and give excellent results. In most dairy sections we have not yet progressed so far in our feeding methods, and the simpler practice of giving hay and grain separately will probably be continued by many, as it gives very fair results.

The best general rule to follow is to put the food of a cow into just that form which seems most palatable to her. Many labor under the mistaken idea that food will not be properly mixed in the rumen unless it is mixed before being swallowed. Examinations of the rumens of cows fed experimentally show that different kinds of feed are all intimately mixed together within half an hour after they have been swallowed, and that the mixing is much more thorough than is possible to get in the feed-box. It is better to let the appetite of the cow govern in that matter rather than the theory of the feeder.

FOODS FOR DAIRY COWS.

First in the requisites place palatability, next quantity, and finally proper proportions of nutrients, being guided somewhat by the German standard as expressed in Tables I. and II. From the large amount of protein represented by the cheese part of the milk and the albumen, it is certain that a very considerable amount of protein should enter into the composition of the food. The carbohydrates supply the material out of which the milk-sugar and the fats are elaborated, though of course these can also be made from the protein substances. The protein and fat of the foods are the more expensive por-

tions, and for that reason we should be carefu! not to feed them in more liberal allowance than is actually needed.

Among grain foods for the dairy the following are worthy of special mention:

Corn.—Indian corn is a most valuable food and one of the cheapest used in the dairy, and the quality of milk and butter produced from it usually above question. Corn meal is a very concentrated food and packs too closely in the stomach, and should be extended with something coarser, like bran, if possible. As the table shows, corn does not furnish much protein.

Oats are probably the best single food on the list, and are just as valuable in the cow stable as in the horse barn. At this station we have found oats to have the value of about 10 per cent in excess of an equal weight of bran for producing milk and butter fat. Oats contain much ash and a larger proportion of protein than corn, and should have a prominent place in the feed-bin of our dairy farms whenever the cost is not too high.

Barley is a very common food for cows in the Old World, and is used to considerable extent on the Pacific coast. It should be crushed by rolling rather than grinding.

Wheat is sometimes so low in comparison with other grains that it can be fed very profitably. Frequently on the Pacific coast it is the cheapest dairy food in the market.

Peas.—Table I. shows peas to contain a very large amount of protein, and they are an excellent food for

dairy cows. Being very rich in protein, but a few pounds should be used in a ration.

Cotton seed.—The progress of Southern live-stock interests depends largely upon an intelligent use of cotton seed, cotton-seed meal and cotton-seed hulls. Cotton seed boiled is used at the South with good results, if fed in reasonable quantity. Cotton-seed meal is very rich and heavy, and should be fed with care ; it should be extended by some other food like bran and mixed with roughage. Cotton seed and cotton-seed meal have a deleterious effect on butter, if fed in large quantities, but with care they can be fed at any season of the year with profit. Cotton-seed meal should be used more generally at the North, its high fertilizing value after passing through the animal often being worth the first cost.

Oil meal or oil cake.—This by-product of the linseed-oil factories is a most valuable food in the dairy barn, though it should be used in limited quantities. It is especially useful for calves, and a couple of pounds a day may be fed to dairy cows with profit. It is very rich in fertilizing elements. Oil meal to the value of $8,000,000 is annually shipped to the Old World. For the fertility it contains, if for no other reason, it should all be fed in this country and dairy products instead shipped abroad.

Bran is one of the most valuable feeds in the dairy. From its loose, husky nature and cooling effect on the system, it can be given in almost any quantity, with little danger of overfeeding. It is the safest food in the dairy barn, and should always be in store to mix with corn meal or the ground grains, cotton-seed meal or oil meal. We know that wheat rapidly depletes the soil of its fertility, and the chemist has found that the larger part of

the fertility that goes into the wheat grain is stored near the outside of the grain in what becomes the bran on grinding. A few farmers still hold that bran is little better than sawdust. Such notions belong to the past generation. Exporters are studying how to compress bran in order to ship it abroad. This movement should be stopped by a lively home demand.

Shorts and middlings are now but a finer form of bran. Sometimes they contain much starch and form a first-class food, but, again, they carry the dirt and dust of the mill, and are not so palatable as bran.

Malt sprouts and brewers' grains, either wet or dried, are valuable foods, rich in protein, and often sell at such low prices as to admit of very profitable use in the dairy barn. Wet brewers' grains, because of their cheapness and abundance, are often misused. The sloppy drainings saturate the feed boxes and mangers and become putrid, endangering the lives of the cows and those who use the milk. If fed when fresh, and in reasonable quantity, and the surroundings kept perfectly clean and wholesome, brewers' grains are an excellent food for dairy cows.

Gluten meal, a by-product in the manufacture of starch or glucose, is very rich in protein. The heavy forms of this meal should be fed cautiously and extended with some light substance like bran.

Corn stover or corn fodder is an excellent and healthful cattle food, being quite free from dust, and very palatable to the cow. The amount of nutriment which can be gathered from a cornfield, and the portion which remains in the stalks, has already been discussed under steer feeding, and the reader is referred to that portion of this chapter for information on this important point.

Clover hay, when well cured and bright, is especially valuable for dairy cows, since it furnishes a large amount of protein.

Timothy hay is at best a poor food for dairy cows; it should be left for horse feeding.

Wheat hay, *oat hay*, or *barley hay*, if cut early, are all excellent dairy foods, and their use should become much more common than it is.

Millet hay is satisfactory if cut very early, before the seeds form.

The reader is referred to Table I. for the proportions of nutrients in the above and many other feeds used in the dairy.

SILAGE IN THE DAIRY.

I have already spoken favorably in regard to the use of silage in steer feeding; in the dairy barn it has a still more important place. Milk is a watery product, and the cow should be fed upon juicy, succulent foods. We all know the value of good pastures, but their season is short in this country, and in the Northern States our cows must subsist on dry feed between six and seven months each year unless we can give them a substitute in the shape of roots or silage. Many dairymen have learned the value of roots, but there are thousands who for one reason or another will not grow them, and to such I strongly urge the use of silage for supplying a moist food most palatable to dairy cows. Silo construction has now been greatly simplified, and we have learned at what stage to cut the corn and how to secure it in the silo at very low cost. An acre of good land will furnish from 15 to 18 tons of green cornstalks, many of which will carry small ears or nub-

bins. This material can be placed in the silo at small cost while full of juice, and kept there with little waste. From 20 to 40 and even 60 pounds of corn silage can be fed to each cow daily during the winter with profit. There is a prejudice among many dairymen that silage being somewhat sour will injure the teeth or the digestive apparatus of dairy cows, but the practical experience of thousands who use the silo show such charges to be without foundation. In the Indian corn crop we have the best and cheapest means of producing a large amount of wholesome cattle food; with the silo we now have the means of keeping this crop in a succulent condition for winter feeding so that it proves an admirable and cheap substitute for roots.

There are two classes of dairy farmers. Those who desire to raise upon their farms about all that is fed to their stock constitute the first class, while those in the second are usually located on high-priced land near some city or railroad station, and cannot grow all of the food required by their cows, and make heavy purchases of grain feed each year. The first class of dairymen here referred to will doubtless find it more profitable to grow such varieties of corn only, for silage, as will fully mature in their locality, and plant the corn so thinly that many ears will form on the stalks. These ears will make the silage very rich, and a fine ration is provided by giving a few pounds of clover hay and 2 or 3 pounds of bran or oats. Where it is desirable to raise a large amount of roughage, the farm furnishing only the bulky feed, let the corn for silage be of some large variety, which will barely mature in the given locality, planted on very rich land, so thick that very few ears will form. The amount of coarse

feed furnished per acre is enormous, but it must be backed up by a full grain ration. Some farmers put silage into the pit without cutting, but a good feed-cutter elevates it so economically, and cut silage packs so well and is so much more easily removed at feeding time, that cutting the corn should generally be practiced.

FOOD REQUIRED TO PRODUCE 100 POUNDS OF MILK.

The dairyman should so study the operations of his farm that he knows what it costs to produce a hundred pounds of milk or butter. The calculation is a complex one, but it is possible, and has been done by a good many farmers, who have found much interest and profit in the work. In order to give some idea of the amount of food required to produce a hundred pounds of milk, I have prepared a table giving the results of observations at experiment stations in four States and Canada.

TABLE XII.—*Food required for 100 pounds of milk.*

Station.	No. of cows.	Breed.	Length of trial.	Grain feed. Corn meal.	Oats.	Pea meal.	Wheat bran.	Wheat shorts.	Oil meal.	Cotton-seed meal.	Roughage. Corn silage.	Green clover.	Green corn.	Fodder corn.	Corn fodder.	Mixed hay.	Oat straw.	Fat in 100 lbs. milk.
			Days	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Wisconsin	5	Holstein, Jersey, Native	125		9.7		24.2								77.3	29.0		4.05
	8	do	84		10.6		15.9				312.0					10.6		4.23
	8	do	84				17.1							113.9		11.4		4.11
	20	do	112				27.5	11.0			326.0					22.0		4.54
	20	do	112				27.5	11.0						103.0		22.0		4.47
New York (Geneva)	2	Jersey	26	14.3			9.6			14.3						94.0		5.44
	2	do		26.6			8.9									86.4		4.95
Maine	5	Holstein, Ayrshire, Jersey	365	15.2			10.2			6.3	35.2					88.5		4.08
	6	do	366	17.0			11.7	.4		7.3						91.9		4.04
Canada	6	do	90								137.4					45.8	91.6	3.67
	6	do	90						13.6	17.0						68.2		3.49
	6	do	90	25.1	15.7	12.6										62.7		3.25
	6	do	90	9.1			16.0				168.6					90.2		3.83
Pennsylvania	7	do	99	7.1	7.2		14.3									127.7		4.15
	7	do	99	9.1	9.1		16.5					479.0				39.6		4.32
	7	do	99	9.8	9.8		12.7						633.4			42.4		4.54

The value of milk is mainly dependent upon its fat content, and a given weight from different herds varies greatly in actual value. For this reason in the last column of the table the amount of fat actually found in the milk is reported. It will be seen that this varies from 3.25 pounds in one case to 5.44 in another. The wide variation is an admirable example in showing how important it is for the dairyman to analyze the milk and learn just what his cows are doing. It shows us how little we know of the value of the herd when we stop short with merely weighing the milk. By weighing the feed occasionally and weighing the milk regularly and analyzing it from time to time the dairyman is in position to know just how his business is running.

FEED WITH A GENEROUS HAND.

All through this chapter I have endeavored to convey the impression that the calf, the steer, and the cow are living machines for the concentration of hay, grains, and grasses into human food. The successful operation of these machines depends upon the manager and is controlled by inviolable laws. Often it would seem from appearances as though the stockman was hostile to his cattle, and regarded every pound of feed given them as so much material filched from the feed bin to his personal loss. The man who wrote in a letter that he had a wife, 3 children, and 6 cows to support, doubtless took just this view of the situation ; had cruel fate thrust 10 or 20 cows upon him he would have broken down entirely under the burden. With some the greatest effort in conducting feeding operations seems to be the study of how to save a a little feed and still keep the animals in existence.

The successful feeder works on exactly the oppposite

principle. He fully appreciates the fact that an animal in order to be profitable must be liberally fed. He understands that first of all it must have sufficient food to carry on the bodily functions and maintain life, and that no returns can come to the owner if only this amount of food is supplied, and that all increase in weight, fat and all yield of milk come through the excess of food over the wants of the body. This leads him to breed and select animals with large consumptive power, a strong digestion, and to feed them up to their limit so long as they are useful.

If our farmers only fully understood the first great law of stock-feeding and acted intelligently thereon, our stock interests would be revolutionized.

THE EYE OF THE MASTER FATTENS HIS CATTLE.

I wish the above legend could be written over the door of every feeding stable in the land, for it expresses a most important truth in concise form. If a man has no natural liking for the stock business, it is really useless for him to attempt that vocation, for the art can only be acquired by students having a certain natural adaptation. If one has this love for the business, then by patience and study the details can be successfully worked out. First comes a love of order and regularity, which are of prime importance at all times. Stock must be fed with great regularity and in the same order day by day, and all possible violent changes in feeding and handling avoided. The feeder should move among his animals quietly and in a way to win their confidence, which is easily acquired and as easily lost. As he passes among them daily in his round of duties he should have a quick eye to scrutinize every member of the herd and detect any little irregularity or

trouble. He avoids disasters or serious accidents by constantly studying the little comforts and individual wants of the animals under his care. He feeds with a liberal hand, and none of his animals lie down hungry or discontented.

The successful management of live stock is dependent upon good judgment in handling the cattle. If one lack this, all his other qualifications count for but little. He may understand the theory of cattle-breeding and how to compound rations from a scientific standpoint; he may know the chemistry of the foods he handles and of the bodies of the animals to which they are fed; he may have the literature of the stock business at easy command, but, if he lacks sympathy for his animals and judgment in handling them, all his knowledge is of no avail.

UNIVERSITY OF WYOMING.

Agricultural College Department.

WYOMING EXPERIMENT STATION,

LARAMIE, WYOMING.

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Geology of the Wyoming Experiment Farms,

—AND—

Notes on the Mineral Resources of the State.

BY THE GEOLOGIST.

Bulletins will be sent free upon request. Address: Director Experiment Station, Laramie, Wyo.

WYOMING

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INTRODUCTION.

BY W. C. KNIGHT.

The object of this preliminary report upon the geology of the Wyoming Experimental Farms is to refer them to their proper geological horizons, to determine the various formations entering into soil compositions and to classify the soils. In reference to this work we can do but little more at this time than draw a few general conclusions and prepare the way for future investigations.

The rock masses which have been decomposed and eroded to form the soils of the state have not been critically examined nor their various constituents determined, so that any formation might be classified as beneficial or detrimental to good soil making. The various geological formations which have entered into the soils of Wyoming range fron Archæan to the Pliocene Tertiary, and the methods of decomposition, pulverizing, eroding and transportation include all known phenomenon.

A study of the soils of Wyoming is especially interesting, owing to the diversity of composition. Some of them have been derived from the entire series of rocks ranging from Archæan to the close of the Tertiary, while others are the result of the decaying of a single geological horizon. There are many subjects of importance relative

to the soils of the state which will receive attention hereafter. Chief among them are the following:

The cause of the decomposition of rock masses.

Climatic action upon rock masses.

Water erosion over various grades and the resulting soils.

Wind erosion.

Wind erosion plays an important part in the transportation of soils in Wyoming, and beyond a doubt has in the past, owing to the incoherent state of the soils, due to the lack of clay. The arid regions of Wyoming, which are chiefly Tertiary and Cretaceous plains and tablelands, receive very little rain. Consequently the soils become loosened by great earth cracks and during the dry and windy winter weather are transported in dense clouds, which almost suffocate travelers, to the broken country and distant hills and mountains. In a single season it is not an uncommon sight to see banks of earth, like huge banks of snow, behind a reef of rock or in the lee of large bunches of sage brushes.

THE LARAMIE FARM.

The Laramie Experiment Farm is located two miles southwest of Laramie upon prairie land 7,200 feet above the level of the sea and probably is the highest experiment farm in the United States. The country round about is rolling, gradually rising toward the Medicine Bow Mountains on the west and on the east falling toward the Big Laramie River, which is only a mile away. The farm, however, is not upon land that has in any way been affected by the waters of the river.

In more general terms the farm is located on the Laramie Plains, which is in a broad valley-like region thirty-five miles east and west and eighty miles north and south. On the west the Medicine Bow Mountains rise to a height of 12,000 feet; on the east the Laramie Hills reach an elevation of 9,000 feet. These two ranges coming together form the southern boundary, and the northern is beyond the limit of discussion. This great synclinal valley which is called a plain is a cretaceous basin with earlier rocks exposed along either rim. The rock masses are seldom exposed in the valley only along the two rivers, the Little and Big Laramies, which rise in the Medicine Bow Mountains, flow north and east, draining the entire valley and empty into the North Platte River. The Laramie Hills on the east are composed of Archæan rocks, chiefly granites. Resting upon the Archæan body, on the western slope, are a series of carboniferous sand and limestones dipping to the west at various angles ranging from 6° to

12° and forming the western slope of the hills for at least twenty miles to the north. Conformable with the upper member of the Paleozic age are the Triassic red sandstones which are overlaid by Jurassic rocks. The Triassic sandstones in this vicinity present some of the most remarkable examples of wind erosion to be found in the Rocky Mountains. Resting upon and conformable with the Jurassic is a complete series of the Rocky Mountain Cretaceous, which covers the valley. The Medicine Bow Mountains on the west is also an Archæan range, but are composed of schists, gneisses, quartzites and granites. The orographic movement which caused the elevation of the Medicine Bow Mountains was from the west, causing the sedimentary rocks on the west side of the valley to assume a perpendicular position. These rocks, although the same as exposed on the east side of the valley, are, with few exceptions, covered with detritus from the Archæan body.

Geologically the Laramie Farm is located on Dakota group (Cretaceous) sandstone, very near the junction of the Cretaceous and Jurassic. The soil of the farm has been brought from the south and west and does not partake of the "red beds" which lie above and to the east only a few miles from the Laramie River. The river seems to have carried away all the material brought from the Laramie Hills, for in no instance have the red soils so common to the Laramie Plains near the Laramie Hills been seen on the west side of the river. This is no doubt due to the existence of the Laramie River before the erosion of the Triassic rocks. Glaciers were instrumental in making the greater portion of the soil of the Laramie Plains. During Quaternary times glaciers existed at the head of

both the Big and Little Laramie Rivers. According to Hague the Medicine Bow Mountains have been lowered many hundred feet and all the eroded material has found its way to the valleys and plains below. Evidences of glacial action are plainly visible in both mountains and valleys. The Laramie Plains during early Quaternary times was an inland sea. The jetting glaciers broke off and laden with glaciated material floated to protruding hills and there wasted away. The boulder covered hillsides are living examples of proof of the latter statement, for only the hillsides facing the ancient glaciers are covered with boulders. The glaciers in moving down the valleys ground up Archæan, Paleozoic and Mesozoic rocks and conveyed them to the plains for soil making. Following the glacial period was one in which a calcarious deposit formed over the glacial boulders, after which the erosion of the waters and wind completed the soil making of the plains. I should not say completed, for not a single windstorm sweeps these plains nor not a rainstorm causes the tinyest rill but the work of erosion goes on, and soil making continues as it has for these thousands of years.

According to Hilgard's classification of soils the Laramie Farm would be called a colluvial, but rich in the life-giving elements and capable of long and heavy tillage with but little assistance from fertilizers.

In studying the gravel associated with the station soil there were found pebbles of schist, gneiss, quartz, orthoclase and granites which were well rounded and worn. Associated with these were a few angular fragments of sand and limestone.

THE LANDER FARM.

The Lander Experiment Farm is located in the valley of the Popo Agie River, 5,500 feet above sea level and five miles south of Lander. This is practically in the foot hills of the Wind River Mountains which rise to the south and west of the farm one mile and a half above the valley. This region is a series of rich table and valley lands, drained by the Popo Agie River and its tributaries which flow north and east into the Big Horn River.

The geology of this region presents many features of great interest, none of which can be discussed here. The upheaval of the Wind River Mountains caused the sedimentary rocks to dip to the northeast at an angle varying from 14° to 20°. For miles along the range there are exposed Paleozoic and Mesozoic rocks which are easily distinguished by the peculiar color of each formation. In many instances there are canons running parallel with the strike of the sedimentary rocks, which have rough and almost perpindicular walls several hundred feet high. The water courses have cut deep canons at right angles with the axis of the mountains, exposing Archæan, Paleozoic and Mesozoic rocks their entire thickness. The dynamic force which cause the elevation of the Wind River Mountains also caused an anticlinal fold to the northeast of the range only a few miles distant. By erosion this anticlinal fold is now a valley, forming for some distance the valley of the Little Pogo Agie River. Paralleling this basin are two synclinal basins, one between the anticlinal and the range and the other on the east. These basins extend

from Fort Washakie southeast to the old crossing of the Beaver River, a distance of over forty miles. The Wind River Range is composed of Archæan granites and schists which are cut by various species of eruptive rock. Overlying the Archæan is a series of metamorphosed sand and limestones together with a reddish conglomerate. Several species of typical Lower Silurian fossils were found in the limestone. Comformable with the Silurian there is a well-developed series of upper carboniferous rocks which form the lower slopes of the mountains along the eastern flank. The Mesozoic age is represented by the Triassic, Jurassic and Cretaceous rocks which are conformable with the Paleozoic. The Cretaceous rocks form the surface of the synclinal basin at the foot of the mountains and beyond the anticlinal there is a well developed Cretaceous coal field from which the people of Lander mine their coal.

The Lander Farm is located upon the Lower Triassic rocks in a cove-like basin which has been cut out by glaciers. Speaking in general, the valley soils are made up of the rock formations lying above them, but in this instance the rock masses above the farm do not enter into the soil composition. In ascending the Popo Agie River from Lander one encounters many terminal moraines. In some instances the boulders are so numerous and so large as to render the land valueless. During glacial times, when the present valley was being formed, the Cretaceous(?) Jurassic and Triassic rocks offered little resistance to the there great erosive agencies. However, when the valley was eroded to within 200 feet of the base of the Triassic then was a ledge of tough gray marble encountered. At this point the valley was widened and the friable red sandstone washed from the hindering formation. Later a gap

was cut through and room for the main channel of the river. In after years the water did not rise above this ledge, consequently the material entering into soil composition had to come principally from the Triassic rocks. The red sandstones and clays decomposed and in time covered a portion of the present farm. The ledge of marble also formed a large amount of soil. The difference in the soil* of the eastern and western portion of the station is easily explainable when it is known that the soils of the eastern side of the station were Triassic red sandstone while the western were made from decomposed marble associated with sandstone.

Thus in a valley where Archæan and Paleozoic rocks have been great soil makers not any portion of them enter into the soil of the farm.

In studying the coarse fragments taken from the Lander Farm soil only angular pieces of sandstone and marble were found. The soil is a colluvial and is not only rich but warm and capable of producing crops that would not mature on a rich black alluvial at this altitude.

THE SARATOGA FARM.

The Saratoga Farm resembles both Laramie and Wheatland. Laramie in its soil composition and Wheatland in its geological position. The farm is one mile northwest of Saratoga on the west side of the Platte River at an elevation of 6,800 feet. The valley of the Platte at this point is quite wide with the Medicine Bow Mountains forming the eastern boundray and the Sierra Madre Mountains forming the western, but not extending as far

*See Bulletin Wyoming Station No. 6, page 17.

north as the farm. South of the station some fifteen or twenty miles the valley terminates at the Platte Canon, which separates this section of the Platte Valley from the North Park, Colorado. North of the station is a broken country extending along the west bank of the Platte River to the Union Pacific railroad. The Sierra Madre Mountains rise to an elevation of 10,000 feet and are Archæan rocks resembling the other Archæan bodies of the state.

The geology of this region is entirely different from that of the Laramie Plains, which are on the opposite side of the Medicine Bow Mountains. After the close of the Mesozoic age, when the mountains were elevated in the vicinity of Saratoga, there was a subsidence. The sedimentary rocks which flanked the Medicine Bow and Sierra Madre Mountains were submerged and over their upturned edges was deposited the Pliocene Tertiary formation. Hence there are no exposures of Paleozoic or Mesozoic rocks along the valley. North of Saratoga a few miles there is an exposure of the Mesozoic which extends north for many miles.

The farm being located upon Pliocene rocks does not necessarily imply that the soil partakes of the formation. From the natural results of erosion one would conclude that the soil would be composed of Archæan matter associated with Pliocene. While both of these formations enter into the soil composition there is a greater factor to mention. Glaciers existed during Quaternary times in the Medicine Bow, the Sierra Madre and the mountains on the east and west of North Park. The glaciers tributary to North Park ground up Archæan, Paleozoic, Mesozoic and Cenozoic rocks and by means of the Platte River the pulverized material was whirled through the Platte Canon

and deposited upon the valley land of the Platte. The river has been the leading agent in bringing the soil to its present resting place. The Sierra Madre Mountain glaciers assisted somewhat in the production of soil with Archæan and Pliocene rocks, but the Medicine Bow glacier was entirely cut off by the Platte River.

The fragments and pebbles found in the Saratoga soil were chiefly Archæan much worn, but were associated with angular fragments of limestone (supposed to be Pliocene).

The soil is a rich alluvial resembling the soil of the Laramie Station.

THE SHERIDAN FARM.

The northern portion of Wyoming has four large valleys rich in agricultural resources and at an elevation of less that 4,000 feet.

The largest of these valleys is the Big Horn, second the Powder, third the Belle Fourche and fourth the Tongue River. The Tongue River drains the greater portion of Sheridan County.

About a mile southwest of the town of Sheridan the Sheridan Farm is located, upon the east bank of the Little Goose Creek and at an elevation of 3,750 feet. From twelve to twenty miles south and west of the farm rise the Big Horn Mountains to an elevation of 5,000 feet above the valley. These mountains trend northwest and southeast.

Extending from the foothills north and east are rich valley and table lands. North of Sheridan and extending to the Montana line is a broken country—coal measure.

With the exception of the valleys this country is not valuable for agricultural purposes.

The Tongue River, with its many tributaries, rises in the Big Horn Mountains, passes through rugged canons, over steep waterfalls and reaches the valleys through deep gulches cut out of sedimentary rocks.

The Big Horn Mountains are chiefly sedimentary rocks, which are occasionally broken through by granites, supposed to be Archæan but not definitely known. The northeast side of the range, where the Tongue River cuts its way through, is an anticlinal fold of metamorphosed Silurian limestone. On the east of this anticlinal the Silurian rocks are well developed, probably the thickest series in Wyoming. Between the Silurian and well known carboniferous rocks there exists a series of sand and limestone resembling the Divonian, but since no fossil remains were found I have deferred judgment until a more thorough investigation can be made. The carboniferous rocks lie high up on the flank of the mountains dipping to the northeast at an angle varying from 10° to 20° and in many instances forming the surface of the range. Resting upon the Paleozoic is a well developed series of Mesozoic rocks. The upturned edges of the Triassic, Jurassic and Lower Cretaceous can be traced to the northwest as far as the eye can reach.

In the valley some seven miles south and west of Sheridan the Laramie group (western coal measures) crops out. In its eastern extension it passes beneath and beyond Sheridan, presenting a great number of veins of lignite coal. This entire section is one of great geological interest, besides being a field wherein but little geological work has ever been done.

The mountains and valleys show no signs of glacial action, although glaciers might have existed in the vicinity of Clowds Peak during Quaternary times. The station is located upon middle Laramie group (cretaceous). The soil has been derived from Archæan (?), Paleozoic and Mesozoic rocks which have been disintegrated and carried down Little Goose Creek. Owing to the nature of the soil and being in the valley it is called an alluvial. There were no fragments or pebbles associated with the soil, which is rich in nesessary plant food and better capable of holding mosture than most of the other stations in the state.

THE SUNDANCE FARM.

The Sundance Farm is located one mile southeast of Sundance in a valley between Sundance and Green Mountain, at an elevation of 4,750 feet above the sea level.

The country about is mainly a rolling and broken prairie with occasional low detached mountains and hills. The largest of the mountain uplifts are the Bear Lodge Mountains, which are north and west from the station. Isolated peaks of eruptive rocks are numerous, such as Inyan Kara, Bald Mountain, Sundance Mountain and the Devil's Tower. The highest of these points is not over 6,000 feet. The valley in which the station is located is drained by a small tributary of Sundance Creek, which is only a brook.

Along Sundance Creek there are evidences of prehistoric thermal springs. Long after Sundance Creek was confined to its present channel there were deposited several feet of debris, over which the waters flowed. Above

this material is a deposit of calcarious sinter, from six to ten feet in depth, in which are leaf impressions and other organic remains, as well as some fresh water gasteropods which are not known in Wyoming at the present day. Above the sinter there are four feet of alluvial soil.

The Sundance farm is located on Upper Triassic sandstone. Below the Triassic rocks there are exposed, along the flank of the Bear Lodge Mountains, carboniferous and Silurian rocks, with an intervening formation resembling the Divonian. Above the Triassic are the Jurassic rocks, which lie along the rim of the valley, to the south and west of the station. West of Sundance Mountain the Cretaceous rocks gradually gain in depth toward the Belle Fourche River.

Sundance Mountain, which is only a mile from the station, to the southwest, seems to have been a pre-Mesozoic eruption, for the Jurassic rocks on the north-east and southwest are horizontal, to within a few hundred feet of the eruptive rock.

If my conclusion be correct this is the first evidence in Wyoming of any pre-Mesozoic eruptions. The farm is hemmed in on the south and west by a rim of Jurassic rocks and opens to the north and east to a broad valley.

The soils of the farm have been derived from eroded and decomposed Triassic and Jurassic rocks, which have not been transported any great distance. These rocks are composed of ferruginous sandstone, chiefly, though they contain some limestone, clays and marls. The decomposition and erosion have been so gradual and so perfect that no fragmentary rocks are to be found. The soil partakes in color of the adjacent formation and is a colluvial, resembling the soil of the Lander Station.

THE WHEATLAND FARM.

The southeastern portion of Wyoming, extending from the Platte river south to the Colorado line and westward to the Laramie Hills, is included in that territory known as the "Great Plains," which extends from the Missouri River westward to the Rocky Mountains.

Near the western limit of these plains, in the northern portion of Laramie county, almost under the shadow of the famous old landmark, Laramie Peak, the Wheatland Farm is located. The country in the immediate vicinity of the station is a rolling prairie, which is cut by a few streams and gulches, all having a northeasterly trend. To the west rise the Laramie Hills, having a maximum elevation of 9,000 or 10,000 feet, while the Wheatland country is not over 5,200 feet. The drainage of this region is confined to Sybille Creek, which rises in the Laramie Hills and flows north and east into the Big Laramie River. The hills west of Wheatland form a rough, broken country, only fitted for grazing purposes.

The portion of the "Great Plains" lying in Wyoming is composed chiefly of Pliocene rocks, which were deposited unconformable with the Paleozoic and Mesozoic formations.

At Wheatland the Pliocene conglomerate lies almost horizontal, and only a few miles west it is found resting upon the Archæan granites. To the north and south of Wheatland, Paleozoic and Mesozoic formations are exposed, flanking the range; but in this vicinity a period of subsidence followed the mountain-making, consequently

the Pliocene lake which covered the southeastern portion of Wyoming submerged the upturned sedimentary rocks of earlier ages and deposited over them many hundred feet of tertiary sediment.

The soil of the Wheatland Farm is a colluvial and has been derived from Archæan and Pliocene rocks without the assistance of glaciers.

On examination of the gravel in the soil there were found well worn pebbles of granite, orthoclase, labradorite, magnetite, quartz and schist, all of which are minerals associated with the Archæan body. Owing to the friable nature of the Pliocene formation it has entered into the fine soil.

The Wheatland and Saratoga farms are located upon the same geological horizon; but owing to the different formations entering into the soil composition in the two vicinities, their soils are of different natures. This evidence leads me to believe that one cannot say that this or that geological horizon is best adapted to certain lines of cultivation. In each and every instance when the question of geological position arises, in the selection of land, the first and all-important question to be settled is from what geological formations the soil was derived, and not upon what formation it rests. For example: In many places in Wyoming rich and extensive agricultural districts rest upon Cretaceous and Tertiary formations that in themselves are detrimental to good soil making.

The following is a tabulated statement referring the various stations in Wyoming to their counties and geological horizons, and giving the names of the various

geological formations which have entered into the soil compositions:

NAME OF STATION.	COUNTY.	GEOLOGICAL HORIZON.	FORMATIONS ENTERING INTO SOIL COMPOSITIONS.
LARAMIE.	Albany	Dakota Group. Cretaceous.	Mesozoic { Cretaceous { Laramie. Fox Hills. Colorado. Dakota. ; Jurassic ; Triassic } Paleozoic { Upper Carboniferous. Archæan.
LANDER.	Fremont	Lower Triassic.	Mesozoic { Triassic.
SARATOGA.	Carbon	Pliocene Tertiary.	Cenozoic { Tertiary { Pliocene, Mesozoic { Cretaceous { Laramie. Fox Hills. Colorado. Dakota. ; Jurassic ; Triassic } Paleozoic { Upper Carboniferous. Archæan.
HERIDAN.	Sheridan	Laramie Group. Cretaceous.	Mesozoic { Cretaceous { Laramie. Fox Hills. Colorado. Dakota. ; Jurassic ; Triassic } Paleozoic { Carboniferous. Silurian. } Archæan.
SUNDANCE.	Crook	Upper Triassic.	Mesozoic { Jurassic. Triassic. }
WHEATLAND.	Laramie	Pliocene Tertiary.	Cenozoic { Tertiary { Pliocene. Archæan.

NOTES

—ON THE—

MINERAL RESOURCES

—OF—

WYOMING.

In the preparation of these notes upon the mineral resources of Wyoming great care has been taken in the field work and in collecting data in order that there may be no misrepresentation. During the last four months nearly every important mineral locality in the state that has produced any mineral wealth has been visited and exact data recorded of development and output as far as such information could be obtained. To those who wish to refer to this report it can be recommended as correct and giving only reliable information. Should there be any resources not reported I wish it understood that it was wholly unintentional on my part and that I regret the fact much more than the person or persons unintentionally slighted.

It will be impossible in a report of this extent to enter into a complete description of all of the mineral districts, mines and minerals, but so far as I am able I will discuss the mineral wealth of the state in general terms.

Upon Wyoming's mineral wealth depends the growth

and prosperity of the state. The production of gold, silver, copper and lead is very small when compared with border states, but when the Wind River and Big Horn Mountains have been prospected the output may be expected to compare favorably with that of any in the Rocky Mountain Region.

Industries are needed which will open the mines and employ an army of workmen. This must be done before the agricultural interests will reach the standard they should, for the farmers in Wyoming can not raise grain and produce and expect to dispose of them in any of our border states, which are well supplied with home products. The only way to obtain a market is to make one, and the way to accomplish this is to utilize the minerals which nature has seen fit to store in these mountains, hillsides, plains and valleys.

Wyoming contains 62,645,120 acres of land; 10,000,000 of which are suitable for agricultural pursuits. Of the remaining 52,000,000 acres there are 22,000,00 acres of mountains and 13,000,000 acres of coal land. The half of the mountainous section is covered with pine and spruce forests and the coal land is underlaid with from one to six workable seams of coal.

In this great extent of mineral bearing country there have been discovered gold, silver, copper, lead, coal, iron, petroleum, soda, asbestus, plumbago, gypsum, mica, tin and a score or more of other valuable minerals. The present condition of our mineral industries, with the exception of coal, is not at all gratifying. The past year has been one of considerable activity in the petroleum, soda, asbestus and gold camps, and good reports from these industries have been sent out. But with all of this there is a great need of more vim, grit and persistency coupled with common sense and backed by a liberal allowance of money.

The coal industry stands out as a grand and beautiful example, the leading industry of Wyoming, employing

over 4,000 men and producing 2,500,000* tons of coal valued at the mine at $4,250,000.00*.

Before 1900 the annual output of coal will not fall much short of 4,000,000 tons. The iron, petroleum, soda and associated industries will be under headway and Wyoming will take her place in the rank and file of large and exceedingly prosperous western states.

The Mining Districts in Wyoming Containing Gold, Silver, Copper, Lead or Tin Briefly Mentioned.

The first mining done in Wyoming was for gold, and strange as it may seem that valuable metal was discovered in Wyoming many years prior to its discovery in either California or Colorado. (In speaking of California I have reference to the discovery of 1848 and not to the old Spanish workings.) Concerning the discovery of gold in Wyoming I will quote an extract from Raymond's report upon the mineral resources west of the Rocky Mountains, 1870, which was taken from a paper known as the *Sweetwater Miner*, published on March 24, 1869, which reads as follows: "Gold in the Sweetwater District was first discovered in 1842 by a Georgian who came here with the American Fur Company for the recovery of his health. After remaining a year he started for home, intending to organize a company and bring them here to work the mines. He never reached his home, however, and was supposed to have been killed by the Indians. Thirteen years elapsed when a party of forty men arrived here. They prospected the whole length of the Sweetwater, found gold everywhere in the river as well as in all of its tributaries and turned the main stream from its channel 400 yards. A small shaft eight feet deep, from which they took from two to ten cents worth of gold per pan, was sunk and worked some time. When winter ap-

*This statement does not coincide with the inspector's report, for he has not considered the production of coal in the state away from mines operated along the lines of railroad.

proached they abandoned their enterprise to winter at Fort Laramie, where they intended to provision themselves for a year and get a supply of necessary tools in the spring. This done they started, but when on their way two days they were overtaken by United States Dragoons and brought back to the fort. The leader was sent to prison for some imaginary offense and the property of the company confiscated.

"In 1858 the leader returned to this region but did no mining until 1860 when he and eight others commenced mining on Strawberry gulch. Their rotten sluices, rockers and toms remain there to the present day. During 1861 mining was abandoned because men could make more money putting up hay and delivering telegraph poles for the Overland Stage Company. In the fall of 1861, however, fifty-two men had collected at South Pass City ready to commence mining in the early spring of 1862. Their locations were selected, and prospects over promising, when like a thunderbolt the Shoshone Indians broke down upon them, robbed them of everything and drove them off. This put a stop to mining operations until the fall of 1866, when a party, led by the same man who led the former expiditions, came down from Virginia City, Montana. They wintered on the Sweetwater and on June 8, 1867, the Carisa lode was discovered by H. S. Reedall. A mining district was organized and called Shoshone District. Mining laws were agreed upon and regulations entered into by the pioneers.

"Reedall and his party commenced working the Carisa lode when they were attacked by the Indians, who killed three of them and drove off the remainder. The survivors returned to the mine July 28, and remained over winter. They succeed in extracting from the cropping of the lode, which they crushed in a hand mortar, $1,600 in gold. Seven thousand dollars more they washed out of the detritus in the gulch below the vein. The news of the success spread rapidly and was greatly exaggerated. A great rush commenced from the neighboring territories,

but the majority of the adventurers not finding the facts to bear out the reports left very soon. Only about 500 remained and went to work. Their labor was well rewarded and gradually more population was attracted, so that in July, 1869, 2,000 people had settled here. * * * * Although all of these people came to the district very poor they had then three stamp mills with twenty-six stamps running and several arastras were in operation."

In the same report, page 336, there is a table which illustrates the great activity in this the first mining camp in Wyoming. The table is as follows:

Table of Stamp Mills in Operation, Under Construction and On the Way to the Mines.

NAME.	NUMBER OF STAMPS.	WEIGHT OF STAMPS.	REMARKS.
1. Hermit	6	650 lbs.	In operation.
2. Miners' Delight	10	425 lbs.	" "
3. Anthony	10	450 lbs.	" "
4. Elkhorn	10	....	Nearly completed.
5. Young America	10	....	" "
6. Kider & Mason	10	....	" "
7. Rice & Co	5	....	" "
8. Collins & Co	10	....	On road.
9. Collins & Co	10	....	" "
10. Wheeler, Hall & Jeffers	20	....	" "
11. Wheeler, Hall & Jeffers	40	....	" "
12. Mammoth	20	....	" "
Total	161	....	....

From 1869 to the present day gold mining has been carried on in Fremont County. As in other localities the camps have had their years of great prosperity and great adversity, but constantly from these mines there has been a stream of gold uniting with that of other sections to swell the river of wealth which has flowed eastward from the Rocky Mountains since 1861. The exact output from Fremont county is not known and there is no way by which it can be ascertained. Up to July 1st, 1869, there had been extracted $155,000. The two following years the production was about the same.

The only estimate of the output from this region is one which has been generally circulated, but upon what

basis the estimate is made or who is its author I am unable to find out.

The estimate is as follows:

Name of Mine.	*Output.*
Miners' Delight	$1,000,000
Carissa	750,000
Caribou	500,000
Buckeye	300,000
Souls and Perkins	500,000
Carrie Shields	100,000
Mary Ellen	100,000
All others	800,000
Placers	800,000
Total	$5,050,000

For the last three years there has been more than ordinary activity in mining pursuits in Fremont county. Many new companies have been organized, new machinery put in operation, and everything signifies a promising outlook for 1894.

At Atlantic City the Garfield Company has erected extensive works on their property, including shaft-house and mill, which will be in operation this fall. They are working on a free gold quartz. The vein has good width and from their test runs mills high in gold. The mill is called a tri-cone pulverizer, and up to the time of my visit had not been tested.

The Diamond Development Company has a property located northwest of Miners' Delight about a mile. This is ore very peculiar in nature, being a Silurian conglomerate about fifty feet in thickness lying almost horizontal. The conglomerate is not hard, but not sufficiently soft to be worked by hydraulic. It is composed of rather fine particles of granite and quartz much worn, with the finer portions highly stained with iron. This formation was called by Hayden Potsdam sandstone and is now locally termed Potsdam cement.

The occurrence of gold in paying quantities in this conglomerate is yet a question. The same formation exists in extensive beds along the Wind River Mountains

and also overlying areas of the Big Horn range. Many have put the question to me, asking if the cement was a paying gold formation. This question I am unable to answer, from the fact that I have not had sufficient time to investigate. A number have promised 100-pound lots for test runs. This information, together with what I might obtain with an extended visit to the field, would enable me to say what I considered the conglomerate worth.

The Diamond Developing Company has erected a roller mill, new to most gold camps, and has thoroughly prospected their property. The results from mill runs made by this company should practically settle the question as to the value of the conglomerate. Should this formation prove to be a paying gold proposition there will not be enough stamp-mill manufacturers in the United States to supply half the mills desired during the coming year.

At Lewiston a Lander company has purchased the Burr mine and has leased the Overland mill and are making improvements by introducing a new pulverizer. The surface ore of the Burr mine is very rich. The property has already produced quite a quantity of gold. This company expect to start up early this fall.

At South Pass there are also new companies developing property and getting ready for treating ore. I regret very much that I was unable to reach South Pass City and look over the camp, so that I could talk more intelligently about their development.

In all these camps there are a great many prospects with good surface indications, but for want of space to mention each one and give it a merited notice I include them in this general statement.

One serious mistake I believe the miners in Fremont county are making—that is the adoption of various kinds of "coffee mills" in the place of stamps. The Huntington mill and a few others work decomposed surface quartz very well, but where hard and to some extent glassy

quartz has to be crushed, no better appliance can be put in for pulverizing than the stamp mill.

The work in Fremont county is not confined to quartz mines. Mr. Emile Granier has been for some years opening up placer mines upon a very extensive scale. His company has constructed a ditch from Christiana Lake to Rock Creek and thence down Rock Creek a total distance of fifteen or sixteen miles. This ditch is to convey water to various gulches for the purpose of placer mining. On account of sickness Mr. Granier was compelled to remain in France this season, so the company's work has been at a standstill. Those who are best acquainted with the proposition claim it to be the largest mining undertaking in the state, and when completed and placed in operation will reward the company amply for their great expenditure of money, as well as for their grit and enterprise in carrying out their scheme.

Other districts in Fremont county have been prospected during the year. Chief among them are the Wood River district, the Owl Creek Mountains and the Snake River. Flattering reports have been sent in from these localities, but owing to their long distance from railroad transportation it was impossible to visit them.

The Mining Districts of Albany County.

Since the discovery of gold in Moore's Gulch in the Medicine Bow Mountains in 1868 the following mining camps have been located in Albany county, the order given being the order of discovery: Last Chance, Douglas Creek, Centennial, La Plata, Keystone and Cummins. There are many other local camps which have not been named.

The Last Chance camp was the first discovery, but prior to 1868 gulch mining had been carried on, by whom no man will ever know, along the lower tributaries to Douglas Creek. Moore's Gulch, which was the richest

digging at Last Chance, was exhausted in 1870, since which time no work has been done, with the exception of prospecting for quartz. This camp yielded about $10,000.

The Centennial camp was discovered in 1875 but not opened until 1876. The most valuable vein of quartz discovered was called the Centennial. This mine operated a ten-stamp mill and extracted $50,000 in gold. On the account of faulting the vein was lost and the mine abandoned. There are many other quartz claims in the district, but none of them are developed.

The Douglas Creek district embraces Douglas Creek and its tributaries. Prior to 1878 this was a placer camp. In 1878 the Keystone mine was discovered, and immediately afterward the Florence. These two mines have produced the bulk of the gold from the Douglas Creek and Keystone camps. At Keystone there is one ten and one twenty-stamp mill. The latter closed down in November, 1892. The product of gold from the Keystone and Florence mines has been $135,000. The gulches have produced approximately $40,000.

THE LA PLATA MINING DISTRICT.

The La Plata district is located under the brow of Medicine Peak. It is a lead and silver camp, the formation being limestone. Owing to the slight development no one knows what the future may bring forth. The ore is galena carrying from 12 to 30 ounces of silver to the ton. Owing to water in large quantities near the surface a pumping plant will be the first requisite in prospecting.

THE CUMMINS CAMP.

The Cummins camp is located on Jelm Mountain and was one day celebrated for its rich gold quartz. Stamp mills were erected and operated for some time but were not made to pay. In and near this camp are valuable prospects of copper, lead and bismuth. The lead is in the form of a large vein of low-grade galena, which must be concentrated before it will be fit for market. The copper is a large vein of pyrites fairly rich in copper but low

grade in gold and silver. This camp has been almost idle for several years.

THE GOLD OUTPUT FROM ALBANY COUNTY.

Name of Mine.	*Output.*
Centennial	$ 50,000
Keystone.	100,000
Florence	35,000
Other quartz mines	4,000
Placer mines.	40,000
Total	$229,000

Carbon County Mining Districts.

In 1872 a party was organized by General L. P. Bradley and Captain Thomas B. Deweese to explore the Seminoe Mountains for a supposed rich silver mine. They discovered the Seminoe gold mines but did not find the rich silver leads. Shortly after the discovery there was a rush as usual for the new gold camp. Development commenced and soon a stamp mill was erected. The Indians caused a great deal of trouble and killed some of the miners. Since 1876 the camp has been active at different times but the companies have not succeeded. All kinds of reasons are assigned for their failure. There are several good looking ledges of free gold ore which, from samples, assay well. The three stamp mills which have been erected have extracted about $10,000 in gold. But little work has been done in the camp during the year except assessments.

THE FERRIS MINING DISTRICT.

The district is ten or twelve miles north of the Seminoe camp. The minerals are galena and lead carbonates associated with silver. The veins are in limestone and have the appearance of being valuable. Owing to a haul of forty miles to the railroad lead ores from this camp cannot be mined at a profit. The galena assays from ten to

twenty ounces in silver and the carbonates from six to fifteen ounces in silver per ton.

This camp has produced a few cars of ore, but the quantity and quality are unknown.

THE GOLD HILL MINING DISTRICT.

The Gold Hill camp was opened in 1890. The veins on the surface were large, strong and very rich, but unfortunately at a depth of 100 feet the ore was not worth milling. A stamp mill was erected and about $3,000 in gold was extracted. No one has seen fit to prospect at greater depths. If the camp ever amounts to anything other ledges different from the present ones must be found or the present ones followed to a greater depth to ascertain their value.

OTHER MINERAL LOCALITIES.

Southwest of Saratoga is a large mineralized country which is being prospected. Gold, silver, copper and lead ores have been found in good sized ledges, but thus far nothing of sufficient value to haul to the railroad for transportation to the smelter at Denver.

North of Rawlins, a few miles, there is a copper district which a company was prospecting during the summer of 1893. The result is unknown.

Uinta County.

There are a great many localities in Uinta County where various minerals have been found. Near Star Valley some very good copper veins were located this season. South of Evanston, near the Utah line, and in the northern part of the county, some gold and silver prospects have been located.

Big Horn County.

The mineral wealth of Big Horn County has not been prospected for to any extent. Silver and lead prospects which are considered very valuable have been located on Clark's Fork and near the head of Stinkingwater River. Galena from these districts assays from forty to seventy ounces of silver per ton. No doubt when Big Horn County is organized it will include the Owl Mountains and Wood River districts, which have been referred to as being in Fremont County. The rough and high mountains in the western portion of Big Horn County will not fail to produce some large and valuable mines.

Sheridan County.

The mines and mining interests of Sheridan County are centered at or near Bald Mountain, which is a large mining district located between the head waters of the Tongue and Little Horn Rivers. By wagon road over the mountains this camp is sixty-five miles west and north of Sheridan. Some three years ago placer gold was discovered at Bald Mountain, since which time several thousand acres of placer land has been located. There is also a conglomerate (Silurian) which resembles the Silurian conglomerate of Wind River Range, which contains some gold but to what extent I am unable to say. Parties who promised samples from various parts of the formation have not sent them in for assay. The work of selecting samples should have been done by myself, but for the want of time it was wholly impossible. The question of placer mining has assumed considerable proportions. The Buffalo Mining Company, the Sheridan Mining Company, the Denver Mining Company and the Fortunatus Mining Company have all located large tracts of placer ground. The Sheridan Company commenced operating a hydraulic in Au-

gust. The Fortunatus Company have done the bulk of the work in the way of development. This company had in operation during July and August a Bucyrus amalgamator having a capacity of 200 cubic yards per ten hours. Not being satisfied with the first machine a new one was ordered with a capacity of 600 yards per ten hours. The new machine was on the property ready for work about September 1st. The result of the work of the Bucyrus machine was very favorably reported by the manager of the company, Mr. H. H. Hawkins. This gentleman informed me that on a test run the ground washed averaged $1 per cubic yard. The gravel is from four to seven feet in depth and with few exceptions would pass through a six-inch sluice box. The reason for using the Bucyrus machine is the lack of water. Owing to the elevation of the camp there is no section of country high enough from which water could be brought in by ditch. Judging from the statement of Manager Hawkins the company have a good paying investment, for according to guarantee, the Bucyrus machine can work the ground for 10 cents per cubic yard. The success of the Fortunatus Company will mean the opening of many more placer mines.

Johnson County.

While there are no regularly organized mining districts in Johnson County there are several localities where prospecting is being done. The Hidden Treasure Mining Company is developing some placer claims at the head of Otter Creek. The gold is coarse and high grade. Not enough work has been done to determine the value of the ground. In the same vicinity there are numerous quartz claims. At the head of Powder River there are several localities where prospecting has been carried on for several years. The value of the ore found is not definitely known.

In the vicinity of Clowd's Peak some copper claims have been located.

Crook County.

The prospects and mines of Crook County have always been more closely identified with Dakota than Wyoming, owing to the cities and towns in Dakota which were their nearest supply stations. All gold taken from the gulches in Crook County has been accredited to Dakota. The prospects of the county are many and varied. The placer gold is nearly all worked out. West of Nigger Hill there are several gold quartz claims that are exceedingly promising. During the last summer a 20-stamp mill was erected upon the Welcome mine, which is located near the mouth of Welcome gulch. Owing to some trouble among the stockholders the starting of the mill has been delayed. The vein is highly stained with carbonate of copper. According to reports the ore will mill $13 per ton.

In the vicinity of Black Butte several claims have been discovered which carry rich silver ores associated with lead. Galena carrying from 100 to 200 ounces of silver has been found in small quantities. Some prospects show small bodies of lead carbonate which are also rich in silver. There seems to be some difficulty in understanding the formation and in being able to keep on the ore bodies. There are several prospects of silver and gold in the Bear Lodge Mountains but not sufficiently developed to determine their value.

For nearly ten years various companies have been engaged in experimenting with the Harney Peak, South Dakota, tin mines. Thus far no methods which have been tested will successfully treat the ore. Just west of Harney Peak on the west side of Nigger Hill, in Wyoming, there is a tin district of considerable size. The ore found is in the form of stream tin, also in well defined veins, large and cropping on the surface for several thousand feet. The camp is well worth a careful and extended report, for all the ore taken from the veins has the appearance of being worth working. Not being able to mention

the claims even by name, I will here embody a statement made in the government mineral statistics for the year ending January 1st, 1887. The following is a list of assays made for the government report of the claims of the Molitor-Trebor group:

Name of Claims.		*Assay, per cent of Tin, per ton.*
No. 1.	Swansea, Nos. 3 and 4	2
No. 2.	Grand Deposit	1
No. 3.	Connection	1.8
No. 4.	Congress	0.125
No. 5.	Valley View	3.25
No. 6.	Chicago	0.25
No. 7.	Montana	0.125
No. 8.	November	0.75
No. 10.	Yankee, sample No. 2	1.30
No. 11.	Uncle Sam	5.36
No. 12.	Uncle Sam No. 2	5.70
No. 13.	Gray Eagle	2.30
	Average	1.86

The average is rather low, but by careful mining it would seem possible to raise the value to 2 per cent or better and thus insure the success of these mines.

Tin ore has been reported from Muskrat Canon and Lander, but in both instances crystals of tourmalines and hornblend have been mistaken for cassiterite (black tin).

OUTPUT OF GOLD FROM CROOK COUNTY.

Sand Creek, placer mines	$150,000
Mallery Gulch Placer	25,000
Poplar Gulch Placer	10,000
Welcome Gulch Placer	2,000
	$187,000

I am indebted to Mr. Charles Blackwell, a pioneer in the Black Hills who has lived and traded with the owners of the above gulches while they were being worked. He says that the above figures are a low, conservative estimate of the placer gold taken from Crook County.

Natrona County.

South of Casper about twelve miles upon Casper Mountain there has been considerable prospecting during the past two years for lead, silver and copper. In carboniferous rock flanking the mountain on the south and west, copper deposits of some extent have been found. Unlike many other copper camps, the ore is found in seams in the limestone apparently having been deposited after the formation was fractured by the mountain uplift. On Casper Mountain there are numerous lead and silver claims. The ore is low in silver, seldom assaying more than twenty-five ounces. The veins are in serpentine and are large and strong. The output from this camp has not been made public.

Laramie County.

Silver Crown, twenty miles west of Cheyenne, is the oldest district in the county, and has been prospected almost continually since 1878. It covers an area of over fifteen square miles. The ores of the district are chiefly copper, carrying gold and silver. Lead ore associated with silver occurs in a few veins. The predominating ore of the camp is copper pyrites, averaging 10 per cent copper and $10 in gold and silver. Ore can be assorted to above 20 per cent copper. In a few instances copper glance has been found in narrow veins which would assay from 40 to 60 per cent copper and fifteen ounces of silver. The camp has a ten ton water-jacket furnace which has been blown in twice and has produced a few carloads of copper bullion and matte. There is also a 15-stamp mill with concentration works, which has not been successful in handling the ores. The lead ores are chiefly a galena with some oxide and molybdate of lead. These ores carry from 20 to 60 ounces of silver.

During the last year a number of companies have been engaged in prospecting and developing, but little information has been made public. The problem facing the men who are interested in this camp is not a difficult one. If they can by any improved method profitably smelt a copper ore carrying 10 per cent copper and $10 in gold and silver per ton they can make a success of mining in Silver Crown.

PRODUCTION OF THE CAMP.

Name of Mine.	*Tons of Ore.*	*Per cent of Copper.*	*Value in Gold and Silver.*
Louise	600	10	$12 00
King David	50	60	15 00 in silver
Colorado	100	10	8 00
Stanton Copper King	25	20	10 00

Adams Copper King, a large tonnage of low grade copper ore.

The above product was partially reduced on the ground and the remainder sold at other points. In no case has the production been accredited to the state.

THE HARTVILLE DISTRICT.

Extending from the Platte River north and east to Rawhide Buttes is a narrow strip of hilly country known as Hartville, Whalen and Muskrat Canons Mining Districts. What we have to say of this country will be under the head of Hartville. In 1880 and 1881 some large deposits of copper ore were found in a carboniferous limestone in the Hartville camp. A large company purchased the leading mine known as the Sunrise, erected a smelter and produced several hundred tons of copper bullion. Since that time the furnace has been operated a few months, so the entire output reaches 1,395,287 pounds. Other deposits of copper were found but only two have been worked, the Green Mountain Boy and the Michigan. The ore taken from the Sunrise and Michigan was an oxide and carbonate of copper, often carrying its own flux. The ore yielded from 12½ to 20 per cent copper. The Green Mountain Boy ore was a copper glance carrying

silver. The ore seldom assayed under 50 per cent copper. The Hartville camp is now the most noted iron camp in Wyoming, but when the iron is mined large and valuable deposits of copper will often be found.

THE OUTPUT OF THE CAMP.

Name of Mine.	*Value of Ore.*
Sunrise	$209,282
Michigan	40,000
Green Mountain Boy	30,000
Total	$279,282

Coal.

Coal was discovered in Wyoming prior to 1834 on the Belle Fourche River. The first discovery which was opened up as a coal mine was made near the Rock Creek crossing in Carbon County. In 1865 the Denver and Salt Lake Stage Company utilized this coal for blacksmithing purposes and for fuel. The mine is located six miles east of the crossing in what has been called "Coal Bank Hollow." There are other coal banks opened up west of Rock Creek but I am informed that this development was later. Hayden in one of his early reports mentions the "Coal Bank Hollow" coal and gives an analysis. This property is now known as the Brown mine.

The rapid construction of the Union Pacific across Wyoming demanded that fuel be found. Prospecting commenced in 1867 and early in 1868 coal had been discovered at Carbon, Point of Rocks and Rock Springs. The Carbon mines produced the first coal utilized by the railroad company, which was 650 tons mined during August, 1868. In a few months the Rock Springs and Point of Rocks mines were ready for operation. For the month

of August, 1869, one year after coal mining commenced, the output was as follows:

Carbon mines for the month of August, 1869	3,481 tons
Rock Springs mines for the month of August, 1869	1,591 tons
Point of Rocks mines for the month of August, 1869	348 tons

For the year 1869 Wyoming coal production was as follows:

Carbon	30,428 tons
Rock Springs	16,903 tons
Point of Rocks	5,426 tons
Evanston (Almy)	4,439 tons
Other mines	990 tons
Total	58,186 tons

The above figures are not as generally reported, for the product of the Point of Rocks mines is generally not considered, and also 2,473 tons of coal mined at Evanston by the Rocky Mountain Coal and Iron Company are usually omitted. The output should be as above stated (see report Mineral Resources west of the Rocky Mountains, 1872, Raymond) and not 49,382 tons.

It is nearly a quarter of a century since coal mining commenced in the state, and in this short time it has developed into the leading industry. The rapid construction of railways and the ever increasing demand for fuel in this and adjoining states will always make coal mining Wyoming's greatest enterprise.

In reporting the coal mines one should enter into a detailed account of each mine and mining district, with sections, analyses and conditions of the formation complete, but in order to do this would necessitate the writing of a volume of 200 pages. It is my aim, however, to give all the information possible concerning the quality and quantity of Wyoming coal together, with such other information as I may deem necessary.

Every county in the state with the exception of Lar-

amie has an abundance of coal land. Coal does exist in the southwest corner of Laramie County, also in Goshen Hole. The coal found in these two localities is very inferior on the surface, but there may be lower seams which are more valuable.

An Approximate Estimate of the Coal Area of Wyoming by Counties.

NAME OF COUNTY.	COAL AREA IN SQUARE MILES.	REMARKS.
SWEETWATER	3313	
CARBON	2421	
CROOK	2360	
FREMONT	2242	
UINTA	2000	
BIG HORN	1820	
CONVERSE	1612	
SHERIDAN	1524	
WESTON	1207	
JOHNSON	1320	
NATRONA	1247	
ALBANY	400	
LARAMIE	Non productive	Two fields not prospected.
Total	21464	

Various estimates have been made placing the coal measure of the state at from 20,000 to 30,000 square miles. I feel quite safe in giving the above estimate, believing that there is more rather than less.

Tabulated List of the Coal mines in Wyoming.

NAME OF COMPANY.	NAME OF MINE.	LOCATED AT	COUNTY.	REMARKS.
Union Pacific Coal Company	No. 1	Rock Springs	Sweetwater	
" "	No. 3	"	"	
" "	No. 4	"	"	
" "	No. 7	"	"	
" "	No. 8	"	"	
Van Dyke Company	Van Dyke	"	"	
Rock Springs Coal Company	No. 2	"	"	
Sweetwater Coal Mining Company	Hopkins	Hopkins	"	
Black Buttes Coal Company	Black Buttes	Black Buttes	"	
Union Pacific Coal Company	No. 2	Carbon	Carbon	
" "	No. 1	Hanna	"	
" "	No. 2	"	"	
Dillon Coal Company	Dillon	Rawlins	"	Supplies local trade only.
Kindt	Kindt	Sage Creek	"	Supplies Saratoga and vicinity.
McCoid	McCoid	"	"	" "
Penn. M. Company	Penn. M	Seminoe	"	Local.
Hurt	Hurt	"	"	"
Fieldhouse	Fieldhouse	"	"	"
Bohack	Bohack	Lost Soldier	"	Opened 1893.
Douglas Company	Douglas	Douglas	Converse	Local.
Deer Creek Coal Company	Deer Creek	Glenrock	"	
Inez Coal Company	Inez	Inez	"	
Cambria Coal Company	Jumbo	Cambria	Weston	
Cambria Coal Company	Antelope	Cambria	"	
Union Pacific Coal Company	No. 7	Almy	Uinta	
Rocky Mountain Coal and Iron Co	No. 5	Red Canon	"	
" " "	No. 6	"	"	
	Cokeville	Cokeville	"	Shut down.
	Hams Fork	Hams Fork	"	"
Wyoming Coal and Coke Company	Twin Creek	Twin Creek	"	"
Monker & Mathers	Buffalo	Buffalo	Johnson	
Diamond Company	Diamond	"	"	Supply Buffalo and Fort McKinney.
W. H. Holland	Holland	"	"	
Sheridan Fuel Company	Grinnell	Sheridan	Sheridan	
" "	Burgess	"	"	
J. F. Becker	Becker	Goose Creek	"	Local trade.
Burgess	Burgess	"	"	
Lander Fuel Company		Pope Agie River	Fremont	
Earl & Gillis		" "	"	Supply Lander and vicinity.
	Gilmore	" "	"	
	Brown	Dutton Creek	Albany	Supply local trade and haul some to Laramie.
	Chase & Farrell	Mill Creek	"	

There are numerous other coal banks opened in the state from which ranchmen and farmers obtain their fuel. Owing to the number and the difficulty in securing data concerning them they have been omitted in this report.

Sweetwater County Coal Mines.

THE ROCK SPRINGS COAL MINES.

The Rock Springs coal mines are located upon the Union Pacific Railway in Sweetwater County. They have been large producers of coal for many years. As the coal industry increases the output of coal from this camp keeps pace with it, and it is only reasonable to expect that this camp will be the leading coal camp in Wyoming for many years to come. The coal is a superior bituminous fuel, being low in water and ash, capable of long transportation and storage with but little waste. The Rock Springs coal has for years been called the best steam and domestic coal mined in the Rocky Mountains. The fact that it is sold from the Missouri River to the Pacific Ocean is a sufficient guarantee of its quality.

In this field there are seven workable veins known. Five of these are being worked. The veins vary from four to twelve feet in thickness and have a uniform dip of 6° to the northwest.

There are four mining companies at work in the field, the Union Pacific, Sweetwater Coal Mining, Rock Springs Coal, and Van Dyke.

The Union Pacific Company, the largest coal producer in Wyoming, operates mines Nos. 1, 3, 4, 7 and 8. These mines have a capacity of 6,000 tons per ten hours.

The No. 1 mine situated in Rock Springs was opened in 1869 and now has its main slope in over a mile. The vein averages ten feet in thickness of clean coal, and has produced more coal than any other mine in the state. Union Pacific No. 3 is just north of the town. This property is operated through a slope over 4,000 feet long and

is over two miles across from east to west faces. The vein varies from four to seven feet in thickness. The Union Pacific No. 4 is on the same vein as No. 1 and produces about the same grade of coal. The two mines are separated by a fault of about ninety feet. Mines Nos. 7 and 8 are upon the same vein. No. 8 is worked through a shaft 180 feet deep and No. 7 through a slope. The vein averages from five to six feet in thickness. These mines are the last ones opened by the Union Pacific Company at Rock Springs and their development is less extensive than in the older opening. On No. 7 there is a Thompson-Houston electric haulage plant, the only electric plant on a coal mine in the state.

All of the Union Pacific mines are well equipped with the best and latest mining machinery. Compressed air is used for drilling and coal mining machines in some of the slopes. The latest improved tipples, box car loaders and screens are used by this company.

THE ROCK SPRINGS COAL COMPANY.

The property of the Rock Springs Coal Company is south of Rock Springs a few hundred yards. This company is working on its No. 2 mine. The main slope is in 1,000 feet. The vein averages six feet in thickness. The mine is provided with steam hoist and all necessary machinery for economical work. Capacity of mine 500 tons per day.

THE SWEETWATER COAL MINING COMPANY.

The Sweetwater Company operates a mine about two miles south of Rock Springs. The main slope is in 3,000 feet. The mine being worked on the raise no machinery is used and the ventilation is by natural draught. This vein averages eight feet in thickness of clean coal. This company, beyond a doubt, mines coal at a less expense than any other company in the state. Capacity of mine, 1,300 tons per day of ten hours.

THE VAN DYKE COMPANY.

The Van Dyke coal mines are east of Rock Springs

about two miles. The property of this company consists of two veins of coal a short distance apart. The upper vein is three and one-half feet thick, the lower four feet. The development consists of two slopes, each of which are in 400 feet. Capacity of the mines 200 tons per day. These seams are the lowest coal veins of the Rock Springs coal field. The mines were opened in 1869, but soon abandoned and not reopened until 1886. The coal is a superior bituminous fuel.

A statement showing the number of coal veins at Rock Springs and the location of the mines:

Number of Veins from the Bottom.	*Mines Worked.*
Vein No. 7	Union Pacific No. 6, abandoned
Vein No. 6	Union Pacific old No. 5, abandoned
Vein No. 5	Union Pacific Nos. 3 and 5
Vein No. 4	Union Pacific Nos. 1 and 4 Sweetwater Mining Company
Vein No. 3	Union Pacific Nos. 7 and 8 Rock Springs Nos. 1 and 2 (No. 1 abandoned)
Vein No. 2	Van Dyke Company
Vein No. 1	Van Dyke Company

OUTPUT OF THE ROCK SPRINGS MINES.

Year.	*Tonnage.*	*Year.*	*Tonnage.*
1868	365	1881	270,425
1869	16,903	1882	287,510
1870	20,390	1883	304,495
1871	40,498	1884	318,197
1872	34,677	1885	328,601
1873	44,700	1886	359,234
1874	58,476	1887	465,444
1875	104,664	1888	662,277
1876	134,925	1889	898,200
1877	146,494	1890	652,408
1878	154,282	1891	1,055,882
1879	193,252	1892	1,248,997
1880	244,460		

THE BLACK BUTTES MINES.

The Black Buttes mines were operated years ago, but until 1891 they had been idle for many years. Since the mine was closed during the summer no data concerning its

development and condition could be obtained. The mine was operated all last winter and will resume this fall. The coal is a good domestic fuel, but carries more moisture than the Rock Springs. In 1891 the mine produced 5,600 tons. The output of 1892, if any, was not reported.

POINT OF ROCKS MINES.

Coal mines were opened at Point of Rocks in 1868, produced 7,256 tons of coal, were shut down and have not been reopened. No reasons are assigned for the abandonment. Judging from the analysis of the coal it is above the average fuel mined in the state and the mines should be in operation at the present time.

Carbon County Coal Mines.

CARBON.

This is the oldest coal camp in the state. For years its production exceeded the output from Rock Springs, but of late the mines have been abandoned except the old No. 2 The Union Pacific Company operate the Carbon mine and have mined all the coal taken from this camp. There are several veins of coal but only one seven-foot vein has been workd to any extent. South of Carbon about two miles, beyond the faulted ground in the southern working of No. 2 mine, the company has opened some new banks which, in time, will probably be worked. The Carbon coal is a superior steam fuel, but not desirable for domestic purposes. The No. 2 mine is worked through a slope dipping to the south about 4° and 4,000 feet long. The vein averages seven feet in thickness. Capacity of the mine 850 tons per ten hours.

OUTPUT OF CARBON MINES.

Year.	*Output in Tons.*	*Year.*	*Output in Tons.*
1868	6,560	1881	156,820
1869	30,428	1882	200,123
1870	54,915	1883	248,380
1871	31,784	1884	319,883
1872	59,237	1885	226,863
1873	61,164	1886	214,233
1874	55,880	1887	288,358
1875	61,750	1888	347,754
1876	69,060	1889	178,832
1877	74,343	1890	210,191
1878	62,418	1891	163,498
1879	75,424	1892	184,317
1880	100,433		

THE HANNA MINES.

The Hanna coal mines, comprising Nos. 1 and 2, are owned and operated by the Union Pacific Company. The mines are located at the end of a spur leaving the Union Pacific railroad at Allen Junction and extending west some twenty miles. The coal mined in this camp resembles the Carbon coal and is utilized by the Union Pacific Railroad as a locomotive fuel. Both mines were opened in 1889. The Hanna No. 1 is opened through a slope, dipping 11° to the southeast. The vein is about twenty-one feet thick including partings, seventeen feet of which are mined. The capacity of the mine is 1,300 tons per ten hours. The No. 2 mine is also opened through a slope, dipping to the southeast 15°. The vein of coal is thirty-one feet thick and the entire seam is to be worked. Capacity, 1,000 tons per ten hours. There are several large coal seams in this field, but many of them contain coal of an inferior quality. These mines are supplied with the finest equipment of coal mining machinery to be found in the state.

OUTPUT OF THE MINES.

Year.	*Output in Short Tons.*
1889	No estimate made.
1890	74,757
1891	133,790
1892	260,414

THE DANA MINES.

The Dana coal mines, Nos. 1 and 2, were opened by the Union Pacific Company in 1889. The mines are on the main line of the the Union Pacific Railroad, about twenty-five miles west of Carbon. The coal veins were very large and easily worked, but owing to the very light nature of the coal unfitted it for locomotive fuel, hence the mines were abandoned in 1891.

OUTPUT.

1890	29,886 tons.
1891	29,336 tons.

THE DILLON MINE.

The Dillon coal mine is located three miles southwest of Rawlins. The slope is in 650 feet. Coal is four feet thick, sloping to the west at an angle of 8° but gradually flattening to a less angle. The product is hauled to Rawlins and vicinity and sells in competition with Rock Springs. Output not known.

THE KINDT MINES.

The Kindt coal mines are located twelve miles south of Fort Steele, near the mouth of Sage Creek. The No. 1 mine is on the east side of the Platte River and has been opened for several years. The vein is almost horizontal, inclined a few degrees to the north, and is three feet in thickness. The coal is very hard and contains less moisture than any coal thus far known in the state. The coal mined here is sold to local trade only. The No. 2 mine is located three miles west of the Plate River on section 14, township 19, range 86. The property is worked through a shaft 108 feet deep. The coal is six feet thick, pitching to the north some 12°. It is a superior quality, very hard and equal to the Rock Springs as a steam or domestic fuel. The product of this mine is sold to ranchers and hauled to Saratoga.

THE M'COID MINES.

Located in the same district as the Kindt mines is

another opening known as the McCoid mine. The slope is in 200 feet. The coal measures four and one-half feet and dips to the north 12°. Most of the coal mined from this opening is sold in Saratoga.

THE SEMINOE COAL DISTRICT.

South of the Seminoe Mountains and extending westward from the Platte River is a small coal field, containing some very valuable coal veins. There are many openings which furnish coal for ranch and mining purposes. The Penn. M. Mining Company's mines, Hurt and Fieldhouse, are the best developed properties. Exact data as to thickness of the veins is not at hand, but they will average over five feet. The coal is a good fuel, ranking in quality between Rock Springs and Carbon.

There are numerous other openings in the county supplying ranches which have not been enumerated. There are also large tracts of coal land undeveloped. South of the Union Pacific Railroad, extending from the Platte River to Elk Mountain, is a large coal field with but few openings. West and north of Rawlins is one of the largest coal fields in Wyoming, of which very little is known. Also along the southern slope of the hills connecting the Ferris Mountains with the Wind River is a large tract of coal land. Mr. Bohack, of Lost Soldier, opened a coal vein in this field during the last summer.

Uinta County Coal Mines.

RED CANON AND ALMY.

The largest coal mines of Uinta County are located at Red Canon and Almy, which are on a spur of the Union Pacific Railroad a few miles northwest of Evanston. These mines are operated by the Union Pacific and Rocky Mountain Coal and Iron Companies. The mines from Nos. 1 and 7 inclusive are all located on one vein of coal ranging from twelve to twenty-seven feet in thickness.

Nos. 1, 2, 3 and 4 have been abandoned an account of fire, which confines the production to Nos. 5, 6 and 7.

THE ROCKY MOUNTAIN COAL AND IRON COMPANY.

The Rocky Mountain Coal and Iron Company operates mines Nos. 5 and 6, located at Red Canon, one mile south of Almy. The No. 5 mine is worked through a slope dipping from 12° to 13° to the east, but gradually flattening to the bottom of the coal basin. The slope is in 1,900 feet. At this mine the coal vein is twenty-five feet thick, twenty-two feet of it being worked. The No. 6 mine is north of the No. 5, being between the Union Pacific No. 7 and No. 5 of the Rocky Mountain Coal and Iron Company. No. 6 slope is in 1,300 feet, starting at 11° but gradually flattening to 6°. The mine in its essential features is the same as No. 5, except the vein has somewhat thinned in its northern extension. These mines are well equipped with machinery and have a capacity of 1,500 tons per ten hours.

At Almy, which is only a mile north of Red Canon Station, the Union Pacific Company operate the No. 7 mine. The slope is in 3,000 feet. The dip was 6° at the surface but in 1,300 feet decreases to a level and gradually rises to the east. The vein varies in thickness from twelve to eighteen feet, lessening to the north. Capacity of the mine 1,000 tons per ten hours. The mine is well equipped with machinery in every respect.

The Almy and Red Canon mines are the only gassy mines in Wyoming. The greatest precaution has to be taken to avoid fire. The mines are somewhat troubled with a caving roof. The refuse from mining as well as all material coming from the roof, has to be taken to the surface, for it fires from spontaneous combustion.

OUTPUT OF THE ALMY AND RED CANON MINES.

Year.	*Output in Short Tons.*	*Year.*	*Output in Short Tons.*
1869	* 4,440	1881	200,936
1870	30,634	1882	211,276
1871	75,032	1883	190,163
1872	127,831	1884	219,351
1873	153,836	1885	234,657
1874	204,705	1886	255,888
1875	134,394	1887	351,423
1876	130,583	1888	369,333
1877	122,016	1889	309,218
1878	116,500	1890	346,928
1879	132,315	1891	335,127
1880	180,918	1892	328,356

*This estimate includes 2,473 tons of coal mined by the Rocky Mountain Coal and Iron Company in 1869, which is generally omitted.

TWIN CREEK MINES.

The Union Pacific Company opened a coal mine in the Twin Creek field in 1882 and operated it for four years. The quality of the coal caused them to abandon the mine for the present. The Twin Creek coal field has a great many veins of coal, some of which are over forty feet in thickness.

OUTPUT OF THE MINE.

Year.	*Output in Short Tons.*
1882	8,855
1883	36,651
1884	45,189
1885	17,207

HAMS FORK MINES.

Coal mines have been opened at Hams Fork on the Oregon Short Line, but their working has been very light and irregular. The output is so small that it has not been considered.

Converse County Coal Mines.

DEER CREEK COAL COMPANY.

The Deer Creek Company's coal mine is located at Glenrock on the east bank of Deer Creek. The mine was

opened in 1888, but has been unfortunate in many respects, which has greatly curtailed their output. The mine is worked through a slope dipping about 5° to the east and 1,600 feet long. The vein averages six and one-half feet in thickness and is free from any foreign matter. The coal is an excellent lignite and is sold along the line of the Fremont, Elkhorn and Missouri Valley Railway for steaming and domestic uses. The mine has a modern coal plant economically arranged. Compressed air was used, but has been abandoned.

COAL OUTPUT.

Year.	*Output in Short Tons.*
1888	13,000
1889	24,000
1890	*27,897
1891	35,000
1892	14,740

*This includes the output of the Fetterman Coal Company.

THE INEZ COAL COMPANY.

The Inez Coal Company, formerly the Fetterman Coal Company, is working the coal mine at Inez on the Fremont, Elkhorn and Missouri Valley Railroad. This mine was opened in 1888. The old workings have been been abandoned and a new slope put in. The slope at the new opening is down 900 feet, dipping to the north-east 17°. The vein averages a little less than five feet in thickness. Capacity, 300 tons per ten hours. The machinery at the mine consists of steam hoists, pump and fan. This coal is in the same field as the Deer Creek mine and resembles the Deer Creek coal. Beyond a doubt it comes from an upper vein. This field is underlaid with at least three workable veins of coal.

OUTPUT OF COAL.

Year.	*Output in Short Tons.*
1888	18,283
1889	17,565
1890	*27,897
1891	13,023
1892	14,397

*Includes the output of the Deer Creek mine.

There are two other coal openings in this field which supply coal to the local trade. One of these is located a few miles west of Casper and the other near Douglas. The one near Douglas is operated by the Douglas Coal Company, which mines coal for the Douglas market only.

Coal mines are also opened on Shawnee Creek, but their production is very limited.

Weston County Coal Mines.

CAMBRIA COAL COMPANY.

The Cambria coal mines are located six miles north of Newcastle on a spur of the Burlington Railroad. This field was opened in 1888 by Kilpatrick Bros. & Collins, since which time it has passed into the hands of the Cambria Coal Company. The coal property of this company comprises several thousand acres, on which there are two large and well developed coal mines, the Jumbo and Antelope. The product is a bituminous coking coal and an excellent steam fuel, and is sold as far east as the Missouri River. Unlike the most of the coal mines in Wyoming these are found in what is supposed to be Dakota group (Lower Cretaceous sandstone).

The Jumbo mine is located on the right hand side of the canon on ascending from Newcastle. The main slope of this mine rises at an angle of 5° and is now in 4,000 feet. The vein averages seven feet in thickness, but contains some bands of impurities called "splint" which have to be separated from commercial coal. Capacity of the Jumbo 1,000 tons per ten hours.

The Antelope mine is on the opposite side of the gulch from the Jumbo. This mine is worked with the slope of the vein, which is the same as in the Jumbo mine. The main entry has passed through the hill and the company is driving the slope as rapidly as possible beneath a high ledge of sandstone on the opposite side of the gulch.

This opening is in about 400 feet. The coal in the new workings of this mine, judging from physical characteristics, is superior to that mined in the Jumbo. The seam holds its thickness and the bands of impurities seem to be growing less. The capacity of the Antelope mine is 1,000 tons per ten hours. These mines are supplied with air drills and mining machines and very modern machinery. They are also supplied with crushers and screens to prepare various sized coal for the market. This being a coking coal, the company has one bank of twenty-five coke ovens. Owing to the sulphur in the coal washers have been put in and the ovens were to be started about September 1st. This is the only coking coal of any value thus far found in Wyoming. The question of preparing this coke and making it suitable for iron smelting is of great importance, since it is located so near the great Hartville iron camp.

OUTPUT OF CAMBRIA COMPANY.

Year.	*Output in Short Tons.*
1889	5,000
1890	200,024
1891	294,960
1892	366,944
Coke output for 1891	2,682 tons.

Crook County Coal Mines.

The coal mines of Crook County are not developed. The occurrence of burr oak along the streams and pitch pine on ridges supplies the settlers with good fuel cheaper than they can mine and haul coal. Coal banks have been opened at Hay Creek, Brier Hill and at a point between Sundance and Moorcroft. The coal is mined from the Dakota group sandstones and resembles the Newcastle. All the coal mined from these properties is sold to local trade.

Sheridan County Coal Mines.

One half of Sheridan County is underlaid with coal. Until this year no large mines have been opened. The farmers and ranchmen mine their coal often upon their own land. While the area of coal land is so great, but little is yet known of the character of the many coal veins. The largest mines have been opened by the Sheridan Fuel Company a few miles north of Sheridan on the Burlington Railroad.

The Grinnell mine is the best developed property of the Sheridan Company. The main slope is in over 600 feet and being driven ahead as fast as possible. The vein is from ten to sixteen feet in thickness and dips about 2° to the east. The coal is a superior lignite. The mine is operated with mule power, but is arranged for a large output. The property was opened this year and has produced 300 cars of coal.

The Burgess mine is three miles north of the Grinnell and is owned by the above company. This mine has a slope in about 300 feet. The vein is no doubt the same as the Grinnell since it has the same characteristics. The output of this property is not known. The above are all the coal mines opened along the line of the Burlington in Sheridan County.

South of Sheridan seven miles, on Big Goose Creek, J. M. Becker is working a vein of coal that ranges from twelve to fourteen feet in thickness. The slope is in 200 feet, dipping to the east at an anle of 5°. This mine has been worked for many years, the coal being sold to farmers and to the Sheridan people. The coal is a true lignite. Output from mine unknown. South of this property on Beaver Creek there is another coal mine from which considerable coal has been mined. This property was closed upon my recent visit. To enumerate all the coal banks in Sheridan County would be an endless task for they are almost as numerous as the farms. All the coal found in the

Sheridan field is a lignite and will make a good domestic or steam fuel, but could not be utilized for locomotive work, unless their present method of consumption be discarded and some new one be adopted whereby these lighter coals could be used.

OUTPUT OF SHERIDAN COUNTY.

Year.	*Output in Short Tons.*
1888	*500
1889	555
1890	650
1891	1,500
1892	2,000

*Estimated.

Johnson County Coal Mines.

The Johnson County coal mines are operated cheifly in the interest of Buffalo and Fort McKinney. The coal area of the county is very large but for the want of transportation is undeveloped. There are three mines opened near Buffalo—the Monkers & Mathers, Diamond Coal Company and W. H. Holland.

The Monkers & Mathers mine is located one mile east of Buffalo. The property is worked through a slope dipping southeast at an angle of 19°. The slope passes through three coal veins. The lowest vein is seven feet thick, dips to the southwest 1° and is the only seam worked. The mine is a model of good workmanship. The coal is a lignite of superior grade. The output of this mine is about 5,000 tons per year.

The Diamond Company's coal mine is located three miles northeast of Buffalo. The mine is opened through a slope dipping 9° until the coal vein is reached. The vein averages six feet in thickness and dips 1° to the southwest. The coal is a lignite, resembling the lignites of Northern Wyoming. The estimated output is between 2,000 and 3,000 tons per annum.

The Holland mine is eight miles northeast of Buffalo. The vein averages eight and one-half feet, but on account of a poor roof only six and one-half feet are worked. The vein is nearly horizontal and entirely free from water. The Monkers & Mathers and Diamond have to pump water. All of these mines use mule power to raise their coal. The output from the Holland mine is about 2,000 tons per annum. The total output from these mines cannot be accurately stated, since much data has been lost.

OUTPUT OF THE JOHNSON COUNTY COAL MINES.

Year.	*Output in Short Tons.*
1888	5,000
1889	5,092
1890	7,470
1891	4,865
1892	*7,000

*Estimated.

Big Horn County Coal Mines.

The Big Horn Basin country, having no towns of any size, has not been prospected to any extent for coal. However it has a large area of coal land. The only banks opened thus far are to supply ranches and a few small villages. Definite information regarding any of these openings was not obtained.

Natrona County.

The coal fields of Natrona County have been prospected to a considerable extent, but no mines of any extent are operated.

The Fremont County Coal Mines.

Since Fremont County has no railroad within its bor-

ders coal mining is carried on only to supply local demand. The Lander Fuel Company, the largest producer of coal in the county, is working a five and one-half foot vein nine or ten miles northeast of Lander. The slope of this mine is 560 feet deep and dips at an angle of 13° to the northeast. This property is supplied with a steam hoist and pumps, and has an annual output of 3,000 tons. Southeast of the Lander Fuel Company's property there are two other coal mines known as the Gilmore and Earl & Gillis. The Gilmore mine is a beautiful seam of coal six feet thick and dips to the northeast from 12° to 14°. The mine is opened by a slope which is in 200 feet, or to the water level, which caused the owners to suspend operations for the present. Output not known.

The Earl & Gillis is only a quarter of a mile west of the Gilmore, being located on another vein. This property has been worked for several years. The slope is in 260 feet. The vein averages four feet in thickness of very good lignite coal. The owners of the mine estimate their annual output at 800 tons. All of the above mines are located in the same coal field, which contains not less than five veins varying from four to eleven feet in thickness and is included in the largest tract of coal land in the county.

ESTIMATED COAL OUTPUT FROM FREMONT COUNTY FOR THE LAST FIVE YEARS.

Year.	*Output in Short Tons.*
1888	*700
1887	*800
1890	*1,200
1891	*1,600
1892	*3,500

*Estimated.

Albany County Coal Mines.

The Brown coal mine located in "Coal Bank Hollow" has been worked for years, but systematic development

commenced in 1891. For twenty years and over ranchmen have plowed and scraped away the clay above the vein and blasted out the coal with powder. The Brown slope is in about 100 feet, at a slight angle. There are three veins of coal within a distance of twenty feet. The coal resembles the Carbon, but contains more moisture and also more ash. Output never estimated.

West of Laramie there are several openings from which coal is being mined. The Kellog, Chase, Towner and Kirst are the leading banks. Exact data relating to each is not at hand. The veins worked are rather large. The coal is a lignite and is sold in Laramie in competition with other coal. A record of the output from these openings has not been kept.

Laramie County.

There are no coal mines worked in Laramie county. Coal has been found in Goshen Hole and also in the southwestern part of the county, but it contained so much water as to make it valueless as a fuel. More extended prospecting may prove that either of these fields contains a vein of fair coal for domestic purposes.

With the great abundance of coal land in Wyoming neither a high grade coking coal nor anthracite has been found. The next great need of fuel in the state will be a first class coke with which to smelt the iron ores. In identically the same coal measures in Colorado both coking coal and anthracite has been found in several vicinities.

To those who would prospect for either I would suggest that work be done in localities where the coal measure has been moulded into mountains, where dykes of eruptive rock cut through the formation or intrusive sheets are lying parallel with it, or in localities were mountains

of eruptive rock have pushed their heads through the coal measures or a lava flow has covered the formation.

In case good coking coal is not found iron smelting will not be retarded to any extent. The lignites can be made into briquettes which will answer the purpose of coke, and the gas producer will utilize the Wyoming coal for all other purposes. It would not surprise me to see, at no late date, a locomotive with gas producer attached so that they might use all kinds of Wyoming coal and not complain of 30 or 40 per cent passing through the screen in the stack and causing great damage by fires. The Fremont, Elkhorn and Missouri Valley Railroad and the Burlington do not use lignites in their locomotives.

*THE TOTAL OUTPUT OF COAL FROM THE WYOMING MINES.

This, however, does not take into consideration all the coal mined away from the railroads.

1868	6,925	1881	628,181
1869	†49.382	1882	707,764
1870	105,295	1883	779.689
1871	147.328	1884	902,620
1872	221,745	1885	807,328
1873	259,700	1886	829,355
1874	219,061	1887	1,170.318
1875	300,808	1888	1,481,540
1876	334.550	1889	1,388,276
1877	342,853	1890	1,870,366
1878	333.200	1891	2,327,841
1879	400,991	1892	2,394.349
1880	527,811		

*Taken from Mineral Resources United States, 1891.
†United States report, 1870.

The following is a list of analyses of the Wyoming coal. The most of them were made in the laboratory of the University on samples that were collected during the summer. This has been done in order to have the analyses made by one method and from average samples of coal so that conclusions of some value might be drawn. The samples have been taken as far as possible from the face of the deepest workings in the mine. In selecting a place for a sample the floor was cleaned up and a channel

cut from roof to floor. The coal was taken in five pound samples from the average of the vein taken in the above manner with impurities taken out. The coal was sacked in the mine and as soon as convenient sent to the University, where it remained in a tight closet until analyzed. The analyses were made during the first two weeks in October.

The method of analysis was as follows: Samples crushed and passed through a twenty-mesh sieve. For moisture, two grams of coal were placed in a crucible and submitted to a hot air bath with thermometer ranging from 95° to 105° C. for one and one-quarter hours. It was found by an additional heating of ten minutes that most of the coal would oxidize. The reason for not allowing the thermometer to register from 110° to 115° was for the fact that at this altitude water boils at 93° C.

For volatile matter a second portion of two grams of the sample was placed over a Bunson burner for exactly three and one half minutes and without cooling heated over a blast lamp for the same length of time. The fixed carbon and ash were estimated from the same quantity taken for the volatile matter by placing the crucible in a muffle furnace to consume the carbon.

Proximate Analyses of Some of the Wyoming Coals.

NAME OF MINE.	WATER.	VOLATILE MATTER.	FIXED CARBON.	ASH.	FUEL.	REMARKS.
Red Canon, No. 5	7.42	36.08	48.50	8.00	84.58	Lower nine feet.
" " 5	7.75	36.55	49.15	6.65	85.70	Upper eight feet.
" " 5	6.81	36.49	47.45	9.25	83.94	Middle two and one-half feet.
" " 6	7.75	35.10	50.60	6.55	85.70	
Almy, No. 7	7.37	34.88	48.75	9.00	83.66	
" 7	8.82	33.55	51.75	5.90	85.30	Lower vein.
Rock Springs, Union Pacific Coal Co. No. 1	5.38	36.42	55.60	2.60	92.02	
" " " " 3	7.17	33.58	55.60	3.65	89.18	East face.
" " " " 3	6.50	37.10	53.65	2.75	90.75	West face
" " " " 4	5.95	34.55	56.10	3.40	90.65	
" " " " 7	6.37	35.18	54.85	3.60	90.03	
" " " " 8	5.95	35.70	55.75	2.55	91.45	
" Rock Springs Coal Co. No. 2	6.22	34.78	55.75	3.25	90.58	
" Sweetwater Coal Co	5.55	36.95	55.70	1.80	92.65	
" Van Dyke	5.67	35.73	56.85	1.75	92.58	Uper vein.
" Van Dyke	6.25	34.50	56.50	2.75	91.00	Lower vein.
Black Buttes, No. 1	14.45	30.07	51.98	3.50	82.05	By E. E. Slosson.
" " 2	14.23	31.00	49.85	4.92	80.85	" "
Rawlins, Dillon	6.55	32.85	54.00	6.60	86.85	
Sage Creek, McCoid,	5.05	34.75	56.15	4.05	90.90	
" Kindt, No. 1	4.87	35.68	55.15	4.30	90.83	
" " 2	5.40	35.80	55.65	3.15	91.45	
Hanna, Union Pacific Coal Co., No. 1	8.72	44.37	38.70	8.21	83.07	By Union Pacific Coal Co.
" " " 2	9.04	45.55	39.25	6.16	84.80	" " "
Dana, " "	10.96	43.41	35.44	10.19	78.85	" " "
Carbon, " " No. 2	7.42	35.43	48.30	8.85	83.73	
Glenrock, Deer Creek Coal Co	13.82	33.03	47.75	5.40	80.78	
Inez, Inez Coal Co	14.65	36.05	42.50	6.80	79.15	
Cambria, Jumbo	5.72	40.13	43.65	10.50	83.78	Coking.
" Antelope	6.72	39.38	44.25	9.65	83.63	"
Buffalo, Monkers & Mathers	14.70	34.30	44.20	6.80	78.50	
" Diamond	14.50	33.35	44.30	7.85	77.65	
" Holland	13.55	35.05	45.30	6.10	80.35	
Sheridan, Grinnell	14.42	33.18	45.75	7.65	77.93	
" Burgess	13.05	37.55	44.70	4.70	82.25	
" Becker	14.10	35.25	38.75	11.90	74.00	
Crook County, Harper	7.88	33.52	43.90	14.70	77.40	

Proximate Analyses of Some of the Wyoming Coals—Continued.

NAME OF MINE.	WATER.	VOLATILE MATTER.	FIXED CARBON.	ASH.	FUEL.	REMARKS.
Crook County, Brier Hill	5.25	41.70	44.98	8.07	86.68	By L. D. Ricketts.
" Hay Creek	8.74	41.20	39.91	10.15	81.11	By Mariner & Hoskiss, Chicago.
Fremont, Lander Fuel Co	11.40	36.60	47.60	4.40	84.20	
" Earl & Gillis	13.25	34.25	48.00	4.50	82.25	
" Gilmore	13.12	33.13	50.40	3.35	83.53	
" Buffalo Fork	8.50	41.15	46.95	3.40	88.10	
Carbon County, Bohack	13.65	39.25	42.60	4.50	81.85	
Albany County, Brown, No. 1 seam	11.85	34.65	47.30	6.20	81.95	
" " 2 "	12.50	38.50	40.95	8.05	79.45	
" " 3 "	8.60	33.75	43.30	14.35	77.05	Ash contained slate.
" Chase	14.50	34.50	44.75	6.25	75.25	
Carbon County, Fieldhouse	12.24	34.31	46.87	6.58	81.21	
" Penn. M. Co	11.01	33.27	48.48	6.24	81.75	
" Hurt	12.02	37.53	45.25	5.20	88.78	
Uinta, Twin Creek	8.58	35.22	49.90	6.30	85.95	Government Report, 1884.
" Hams Fork	15.64	49.30	38.97	3.21	88.27	" "
Sweetwater County, Point of Rocks	8.54	30.60	52.34	8.52	82.94	" "
Laramie County, Goshen Hole	21.37	35.46	33.74	9.43	69.20	
" "	23.47	36.45	29.50	10.48	65.95	
Wyoming and Utah Railroad Coal	3.53	43.58	51.36	1.53	94.94	By company chemist.

All coal analysis not otherwise reported were made by Wilbur C. Knight.

The coal found by the Wyoming and Utah Railroad is a remarkable product for surface coal. The engineer in charge, Mr. Charles S. Roggers, kindly furnished me the above analyses, showed me a piece of coal, but would not make public the locality.

Petroleum.

The date of the discovery of petroleum in Wyoming has been placed at 1863 or 1864. The discovery antedates this estimate by thirty years. In proof of this, I will quote from Washington Irving's book, "Captain Bonneville," page 142: "In this neighborhood (referring to the Popo Agie River) the captain made search for the great tar springs, one of the wonders of the mountains; the medical properties of which he had heard extravagantly lauded by the trappers. After some toilsome searching he found it at the foot of a sand bluff a little to the east of the Wind River Mountains, where it exuded in a small stream of the color and consistency of tar. The men immediately hastened to collect a quanity of it to use as an ointment for the galled backs of their horses and as a balsam for their own pains and aches. From the description given of it, it is evidently the bituminous oil, called petroleum or naphtha, which forms a principal ingredient in the patent medicine called British Oil. It is found in various parts of Europe and Asia, in several places in the West India Islands and in some places in the United States. In the state of New York it is called Seneca oil, from being found at Seneca Lake."

From this statement we learn that petroleum was known some years before Bonneville made his discovery. Strange as it may seem these springs are called by many "Tar Springs" today. The springs referred to by Bonneville are beyond a doubt the Murphy Spring on the Little Popo Agie River, where the Murphy Wells are located.

There is a great deal of information connected with the oil springs prior to 1870 which is well worth repeating, but which I will not refer to here. The oil fields are so large and so numerous that a mere mention of each with a slight description will occupy all the space set aside for this topic.

Three great railroad companies are now operating in this state, but none of them have penetrated the large oil fields. The Northwestern railroad will no doubt be the first to furnish transportation for Wyoming oil.

The development of the oil interests has been carried on under great difficulty and expense. The long distance from transportation has made living expenses extremely high and drilling very expensive. Yet in the face of all this, active development commenced in 1880 and has been constantly kept up. Another drawback arose from the fact that the oil fields were in a different geological horizon from those of Pennsylvania and the east. Experts who were familiar with the eastern oil phenomenon were considerably perplexed while examining the western fields, and in many instances made serious mistakes. The well drillers of the east have frequently turned their faces homeward, after losing their drills and finding it impossible to recover them. The reason for this was the great difference between the solid Carboniferous and Divonian formations of the east and the varying formations of the western Cretaceous. In drilling for oil in Wyoming a driller must prepare to encounter shales, marls, loose and soft sandstone interstratified with clays and hard bands of sandstone. I know of one well which was drilled in Cretaceous rocks, where they were compelled to commence with a sixteen-inch bit in order to get a hole sufficiently large to case off caving strata and get a six-inch well at a depth of 500 feet.

The study of the oil fields is in its infancy, and no man is sufficiently posted to enable him to select a place in any of the oil fields, where a flow has not been obtained, where he can consistently say that a good flow could be procured.

The Wyoming petroleum is found in geological formations ranging from Upper Carboniferous to the Upper Tertiary. The most of the fields, however, are Mesozoic, and the greater part of the oil has been found at various horizons in the Cretaceous. The most of the counties in

the state have large areas of oil land, the majority of which is unprospected. Oil springs are numerous and in many instances sheets and deposits resembling asphaltum are found below the overflows. The natural oil has been utilized by overland freighters for wagon grease, and at one time was sold in small quantities to the Union Pacific Railroad as a lubricant.

In order to condense this article I have arranged a table which will give much general information pertaining to the Wyoming oil fields. The area given is only a rough approximation but will serve as a guide until the limits of the fields have been established. Some of the material in this table has been obtained from the Territorial Geologist's reports for the years 1886 and 1888:

Name of County.	Name of Field.	Approximate Area in Square Miles by Counties.	Geological Horizon of Oil.	Specific Gravity of Oil—Baume.	Number of Springs.	Oil Wells.	Depth of Well in Feet.	Oil Production in Barrels per Twenty-four Hours.	
Fremont	Washakie	120	Triassic	33 16°	40	None.			Mill Creek Spring. Washakie Springs.
"	Shoshone		Triassic and Carboniferous(?)	22.8°		3	300 to 800	600	Gravity by Slosson.
"	Beaver		Fox Hills	14.5°		None.			
Natrona	Dutton	200	Fort Benton		A great many.				
"	Big Horn		Dakota						
"	Rattlesnake		Dakota	11°					
"	Argo		Dakota						
"	Seminoe		Dakota	31 to 34°		1	900(?)	No report.	
"	Salt Creek		Triassic(?)	25.4°		2	700 to 1070	20	Gravity estimated by E. E. Slosson.
Johnson	Powder River	80	Dakota	21.5°	Many.	1	1005	No report.	
"	Salt Creek		Triassic(?)			2			
Big Horn	No Wood	70	Ft. Benton	31.5°	Many.				
"	Stinkingwater								
Uinta	Carter	40	Fox Hills		20	2		No report.	
"	Twin Creek		Tertiary						
Crook	Belle Fourche	90	Dakota(?)	21.3°	Many.	1		5	Gravity by Slosson.
Weston	Newcastle	60	Dakota(?)	22.5°	Several	2		No report.	

For the last three years extensive development has been carried on in Natrona county. Three companies have drilled wells and all of them found oil. George B. McCalmont represents a large corporation that controls the Salt Creek oil field, which is partly in Natrona and partly in Johnson county. Since 1890 this company has drilled four wells, three of which were producers, but owing to an accident one of them has caved and cut off the oil flow. The other two wells, which are 879 and 1,070 feet deep, will yield with a pump twenty barrels per twenty-four hours. The oil is a superior lubricant. It is a dark olive green color when pumped from the well, and owing to its gravity is an exceptionally good lubricating oil. It has been tested in many ways locally, from the housewife who uses it on her sewing machine to the locomotive engineer who puts it in competition with high grade cylinder oils of the east. The universal verdict has been, "The best natural lubricant we have ever seen." Mr. McCalmont is now endeavoring to secure transportation for the oil eastward. The only drawback is that the wells are fifty miles north of Casper, and it will be necessary to haul the oil to the railroad or invest a large sum of money in a pipe line. An analysis of this oil will be found at the termination of the article on Petroleum.

West of the Salt Creek field in the Powder river country the Seymour company has drilled a well 1,005 feet deep. Oil was found at 884 feet and at various intervals below. Owing to some accident the water was not cased off and a cave resulted which stopped the flow of oil. It was impossible to secure any of this oil for analysis.

West of Casper twenty-five miles on Poison Spider Creek, near Oil Mountain, a company represented by Mr. Guthbery drilled a well during the past year. Oil was struck at about 900 feet. Unfortunately this well caved so that no oil could be secured. Up to date Natrona county, the largest oil territory of the state, has two producing wells.

—(13)

Crook County.

Extending for many miles north and south on the east slope of the Belle Fourche Valley is a series of Cretaceous rocks that are oil bearing. The numerous oil springs caused considerable drilling in this locality a few years ago, since which time no further development has been carried out. One producing well was drilled by the Wyoming Standard Oil Company, that had a capacity of five barrels per day. The oil has a black, almost tarry color when pumped. It is a superior lubricant and was for years sold to the mining companies in the Black Hills* at $28.00 per barrel.

The oil field of Crook County has a large area and promises to be one of great importance.

The flow of the Wyoming Standard well cannot be taken as a criterion, for unquestionably the greatest oil producing horizon was not reached. The springs in the same vicinity have yielded large quantities of oil. J. S. Harper informed me that the production of these springs was from a few to eighteen and twenty gallons of oil in twenty-four hours. If the spring production of this field can be compared with the spring production of the Shoshone oil field, the companies can look forward to a large flow. The Shoshone Spring, which is now called the Murphy Spring, did not furnish a large quantity of oil, but a well drilled near by has an output of 200 barrels per twenty-four hours.

Weston County.

The Weston County field was once called Skull Creek, but of late has been rechristened the Newcastle. The oil territory of this county lies west and north of Newcastle. The development of the field has been vigorously carried on for the last three years. One well reached the oil

*Territorial Geologist's Report, 1888.

horizon at 1,000 or 1,200 feet. It was impossible to case off the water from the oil. The exact or even an approximate estimate of the production from this well could not be made. The casing was extended a few feet above the surface and punctured to allow the flow of water to escape. In this way considerable oil has been collected in the casing above the water level. A second well is now being drilled. In September it was 1,000 feet in depth and the company expected to reach the oil zone sometime during late fall or early winter. Samples of this oil were to be sent to the University for analysis for this report, but owing to their failure in arriving in time, much to our regret, nothing can be said as to the value of the oil. Judging from hearsay and samples displayed at the Cheyenne Mining Convention, 1891, the oil is light and would produce considerable kerosene as well as lubricating oil.

Big Horn County.

The most important oil field in Big Horn County is the No Wood District. Oil has been reported from the Stinkingwater River but to what extent the oil field is or the quality of the oil is not known. The No Wood oil is a light green fluid as taken from the spring, and resembles in color the Salt Creek oil. In this district there has been no development, other than working assessments. From the holes dug small quantities of oil are taken. The field is one of much promise. An analysis of the oil will be found at the close of this article.

Fremont County.

The oil fields of Fremont County were the first known in the state, as well, as in the Rocky Mountains. They were also the first to be developed. The first producing well was obtained in the Shoshone field in

1883. The work was done by an Omaha company with the late Dr. Graft at its head. This association put down three producing wells in the Shoshone basin, and sank one well to considerable depth in the Beaver Basin. The Shoshone oil field is on the same anticlinal as is found at Washakie, and the oils for physical characteristics appear the same. On both sides of the Shoshone Basin there are synclinal basins which are also oil bearing. The oil found in the Triassic rocks is a black color, but the oil found in the Cretaceous above is a beautiful green shade. Both of these oils contain considerable kerosene, as will appear from the analysis. There have been attempts at drilling wells in the Shoshone Basin south of the Murphy wells, but oil was not obtained. The reason, no doubt, was on account of the Triassic sandstone dipping rapidly to the south and the well owners not drilling deep enough to reach the oil horizon. The three Murphy wells are located in a triangular shape about 1,000 feet apart. The depth drilled varied from 300 to 800 feet, but the output seemed constant. These wells are packed, but the packers leak and several thousand barrels of oil are stored in an arm of the Popo Agie River that has been dammed off. This oil has been utilized as a fuel by the Lander flouring mill and at the present time is being used as a fuel at the Burr mine at Lewiston. From careful estimates made by competent men the Murphy wells will produce 600 barrels per day. This output can be increased by simply sinking more wells. When the Northwestern Railroad builds up the Sweetwater it will pass within twenty or twenty-five miles of these wells.

Johnson County.

The oil fields of Johnson County are the same as in Northern Natrona County, the Salt Creek and Powder being partly in each county. The statement regarding those localities found under the head of Natrona County are equally applicable to Johnson County.

Uinta County.

There are two oil fields in Uinta County, the Carter and Twin Creek, besides several localities where oil signs have been found. At Carter two wells have been drilled but caved in. No late development has been carried on. The close proximity of these fields to railroad facilities and the need of both burning and lubricating oil in the west, would seem to be stimulus enough to encourage some large company to open up one or both of these fields. Nothing is known about the nature of the oil.

The following analyses of oil from the Shoshone Indian Reservation, Murphy wells, Salt Creek wells and the Belle Fourche field were made in the University by Prof. E. E. Slosson. The samples were collected during the last summer. The oil from the Shoshone Reservation was taken from a spring some three miles north of Lander. The long exposure of light petroleums as they exude from the springs necessarily caused the evaporation of a large percentage of the lighter oils, which are classed as naphthas, gasoline, cymogenes and rhigolenes. The oils taken from the oil springs and submitted for analysis invariably have a gravity of from two to five degrees (Baume) heavier than the oil taken from the wells. The oil from the Reservation north of Lander is, as far as known, the lightest oil found in the state. The analysis does not show any naphtha or lighter products, which will no doubt accompany the crude oil when taken from a well. It will be seen from the assay that the oil contains about 25 per cent of excellent kerosene and 65 per cent of lubricating oil. The lubricants can be re-classified into various grades, which would depend upon the class of work the oil was to be used for.

The Murphy oil was taken from the leakage from the No. 1 well. Previous analyses upon this oil have not reported any oil lighter than kerosene, but the one made by Prof. Slosson proves the presence of naphtha and there may

be even lighter oils in small quantities. The chief constituents of the oil are, however, about 20 per cent kerosene and 65 per cent of lubricants, 20 per cent of which ranks among the best lubricants known.

The Natrona county oil was obtained from Judge McCalmont, in Casper, who had a barrel that had been brought from the wells only a short time previous to getting the sample. This oil is truly remarkable, considered from any standpoint. Not even kerosene in any appreciable quantity is found in this oil, to say nothing of the lighter products. The average Pennsylvania oil produces from 40 to 70 per cent kerosene. The Salt Creek oil contains 90 per cent of lubricants, which can be classified as 60 per cent of medium grade and 30 per cent of extra high grade oils. This oil is beyond question one of the finest, if not the best, crude oil for lubricating purposes that has ever been discovered.

The Belle Fourche oil being obtained from J. S. Harper in Sundance, the exact locality from which the oil was taken is not known, although we know that it came from the Belle Fourche oil field in Crook County. This oil contains a very little kerosene, together with about 55 per cent of medium lubricants and 22 per cent of high grade. These four oils, coming as they do from various fields in the state, give one a fair idea of Wyoming petroleum. The oils are essentially lubricating of high grade and are more valuable than if they were high grade illuminating oils.

The study of Wyoming oils from a geological, chemical and mechanical standpoint will be continued during the year. Experiments will be made in different processes of distillation, and tests of the comparative lubricating values of the products will be made upon a frictional machine purchased for this purpose. Those interested in Wyoming petroleum are requested to send samples of not less than one gallon to the University in order that the report to be published on the petroleum of Wyoming may be made as complete as possible.

Assay of Petroleum from Shoshone Reservation, Two Miles North of Lander, Fremont County.

Crude oil is brown by transmitted and olive green by reflected light. Specific gravity, .8635 [33.1° B.] On fractionating into ten parts it gives the following products:

NO OF DISTILLATE.	BOILING POINT. Centigrade.	BOILING POINT. Fahrenheit.	SPECIFIC GRAVITY.	DEGREE BEAUME.	COLOR.	REMARKS.
1	110°-180°	230°-356°	.7970	47.1	Colorless.	Flashing point, 27° C. [80° F.]
2	180°-210°	356°-410°	.8200	42.0	Faint yellow tint.	" 50° C. [122° F.]
3	210°-240°	410°-464°	.8350	38.9	Pale yellow.	" 71° C. [160° F.]
4	240°-260°	464° 500°	.8480	35.9	Yellow.	....
5	260°-280°	500°-538°	.8580	34.2	Dark Yellow.	....
6	280°-340°	538°-644°	.8642	32.9	Yellowish red.	Green fluorescence.
7	....	....	.8790	30.1	" "	" "
8	....	....	.8770	30.5	Red.	" "
9	....	....	.8640	33.0	"	" "
10	....	....	....	....	Black.	Melting point 35° C. [95° F.]

Assay of Petroleum from the Murphy Wells, Fremont County.

Crude oil; black, specific gravity .9210 [22.6° B.]

NO. OF DISTILLATE.	BOILING POINT. Centigrade.	BOILING POINT. Fahrenheit.	SPECIFIC GRAVITY.	DEGREE BEAUME.	COLOR.	REMARKS.
1	100° -155°	212°-311°	.7720	53.1	Dull straw.	Flashing point, 19° C. [66° F.]
2	155° 200°	311°-392°	.8180	42.5	Dull straw, darker.	" 60° C. [140° F.]
3	200°-240°	392°-464°	.8430	37.2	Same as No. 2.	....
4	240°-260°	464°-500°	.8570	34.4	Bright straw.	....
5	260°-265°	500°-510°	.8618	33.4	Light brown.	....
6	265° 270°	510°-518°	.8730	31.2	Reddish brown.	Green fluorescence.
7	270°-290°	518° 544°	.8745	30.9	" "	" "
8	290° 293°	540°-559°	.8841	29.3	Dark red.	" "
9	293°-320°	559°-608°	.9220	22.4	" "	Eight per cent only.
10	....	....	....	....	Black.	Coke 12 per cent.

Assvy of Petroleum from Salt Creek Basin, Natrona County.

Crude oil; red by transmitted and olive green by reflected light; specific gravity, .9050 [25.2 ° B.]

NO. OF DISTILLATE.	BOILING POINT. Centigrade	Fahrenheit.	SPECIFIC GRAVITY.	DEGREE BEAUME.	COLOR.	REMARKS.
1	220 °-110 °	248 °-410 °	.8600	32.6	From dull straw color by regular gradations to the color of the crude oil.	Flashing point, 50 ° C. [121 ° F.]
2	210 °-265 °	410 °-510 °	.8710	32.4		" 98 ° C. [210 ° F.]
3	265 °-275 °	510 °-528 °	.8770	30.3		....
4	275 °-280 °	528 °-536 °	.8730	30.4		....
5	280 °-285 °	536 °-544 °	.8622	33.3		....
6	285 °-290 °	544 °-554 °	.8393	38.0		....
7	290 °-320 °	554 °-608 °	.8518	35.4		....
8	320 °-340 °	608 °-612 °	.8610	33.4		....
9	....	....	.8883	28.4		....
10	....	....	....	....	Black.	Coke.

Assay of Petroleum from Belle Fourche, Crook County.

Obtained from J. S. Harper, Sundance. Crude oil; dark brown; specific gravity, .9285. [21.3 ° B.]

NO. OF DISTILLATE.	BOILING POINT. Centigrade.	Fahrenheit.	SPECIFIC GRAVITY.	DEGREE BEAUME.	COLOR.	REMARKS.
1	120 °-160 °	248 °-320 °	.8395	37.9	Dull yellow.	Flashing point, 48 ° C. [116 ° F.]
2	160 °-170 °	320 °-338 °	.8760	30.7	Reddish yellow.	" 49 ° C. [120 ° F.]
3	170 °-190 °	338 °-374 °	.8612	33.5	" "	" 55 ° C. [132 ° F.]
4	190 °-200 °	374 °-392 °	.8691	32.0	Red.	Green fluorescence.
5	200 °-210 °	392 °-410 °	.8490	36.0	"	" "
6	210 °-215 °	410 °-420 °	.8675	32.3	"	" "
7	215 °-220 °	420 °-428 °	.8850	29.0	Opaque, olive green.	....
8	220 °-230 °	428 °-446 °	.8820	29.5	" "	....
9	....	....	....	....	" "	Two per cent only.
10	....	....	....	....	....	Coke 18 per cent.

The following oil analyses have been published in the reports of the Territorial Geologists, and they are appended here in order to give a better idea of the Wyoming oils:

ANALYSIS OF THE MURPHY OIL, FREMONT COUNTY.

By Messrs. Wyner and Harland, of London, England. Specific gravity, 23½ ° Baume.

Kerosene, sp. gr. 807 °, flashing at 110 ° F.	17.00	per cent
Lubricating oil, sp. gr. 810:824	21.00	"
" " " 840:844	20.00	"
" " " 906	27.00	"
Coke	14.00	"

It will be observed that the oil assayed by Prof. Slosson is lighter than the oil analyzed by the London chemists and that it contains more kerosene, some naphtha and 2 per cent less coke. The quality of this oil has evidently changed since about 1884 when the above analysis was made.

ANALYSIS OF THE RATTLESNAKE OIL, NATRONA COUNTY.

By Messrs. Wyner and Harland, London. Specific gravity, 992.

Kerosene	None	
Volatile below 600 ° F. { Lubricating oil, sp.gr. 854 to 860. Flashing at 150 ° F.	29.80	per cent
Volatile at 650 ° F.; lubricating oil, sp. gr. 833; flashing at 270 ° F.	7.40	"
Lubricating oil, sp. gr. 950; flashing at 306 ° F	23.00	"
Coke	30.00	"
Loss	9.80	"

No Wood Oil Analysis, Big Horn County.

By W. H. Kent, Ph.D., Brooklyn. Specific gravity of oil .8822-29.2 Baume.

PRODUCTS.	PER CENT.	SPECIFIC GRAVITY.	BAUME.	TEMPERATURES.
Gasoline	2.05	.7967	46.7	26 ° to 100 °
Naphtha	3.02	.8109	43.5	100 ° to 130 °
Benzine	3.89	.8189	41.8	130 ° to 160 °
Kerosene	28.47	.8461	30.1	160 ° to 210 °
Mineral Sperm	42.97	.8439	36.6	210 ° to 260 °

Iron.

Wyoming iron deposits, with the exception of one instance, have not attracted capital to any great extent. There are two reasons for this—the long distance from market and no means of transportation. No deposit of iron ore in the state, of any importance, can be reached by rail. While this condition does not impair the quality of the iron ores, it does depreciate the value of the iron mines.

Iron ores of various grades have been found in every county in the state and in most instances in connection with limestone and lignite coal.

Carbon County Iron Mines.

RAWLINS HEMATITE.

Two miles north of Rawlins there is a large deposit of red hematite ore, occurring in a metamorphosed sandstone capped with limestone. The exact extent of this deposit is not known since the development has been to extract ore to ship to Salt Lake as a flux or to be manufactured into paint. The ore is remarkably pure. In this vicinity there are several other locations which contain similar deposits. It has been said that the Rawlins hematite carries $8.00 to the ton in gold. If this is true it was the reason for the Salt Lake smelters shipping their iron such a long distance.

The output of ore has been several thousand tons but no record has been kept.

ANALYSIS OF RAWLINS HEMATITE.

Peroxide of iron	94.22
Silica	1.71
Sulphur	1.24
Phosphorus	Trace.
Titanic acid	None.
Water	0.37
Ca., Mg. and Mn., no estimate	——

SEMINOE IRON DEPOSITS.

One of the largest deposits of iron in Wyoming occurs in the Seminoe Mountains, at the foot of Bradley's Peak. Bradley's Peak has been called a mountain of iron ore, containing not less than 1,500,000,000 tons, and when smelted would produce 750,000,000 tons of pig iron. I made a careful examination of this deposit in 1888, and judging from what I saw the estimate is by far too high. On the south and west side of the peak iron ore extends for a distance of a mile and a half and as near as I could ascertain about three-quarters of a mile in width. This entire mass has been called the iron deposit. It does contain iron, but as a whole it is too silicious to be of any value for iron making. There are, however, masses of pure hematite of unknown extent existing in this deposit of silicious iron. The owners of the property have not prospected these masses of iron ore to know their thickness nor their width, and until such work has been done no one can make a true estimate of this deposit. This locality will furnish an important part of the iron ore to be smelted in Wyoming.

Analyses of Seminoe Iron Ore.

CONSTITUENTS.	BY H. E. WOOD.	BY H. E WOOD.	BY H. E. WOOD.	NEW YORK METAL WORKS	ANDREW S. M,CRATH.
Metallic iron	55.30	29.50	63.56	68.60	61.350
Oxygen	23.91	25.50	27.25		
Silica	20.10	15.00	2.68	4.30	
Titanic acid			.03	Trace.	
Phosphorus			None.	None.	0.046
Manganese			None.	None.	0.042
Zinc				None.	0.076
Copper				None.	0.013
Sulphur				Trace	0.005
Arsenic				None.	0.006
Phosphorus in 100 parts of iron					0.075

These analyses were taken from Dr. Rickett's report of 1890.

From the analyses I judge that the first two are from samples taken from the silicious ores, and the last three from the masses of good hematite. This section is well situated for iron making, everything being near at hand except coke. There may be some method of smelting

adopted whereby the non-coking coal may be utilized. The building of the new cut-off from Casper to Hanna will enhance the value of this camp very materially.

Laramie County Iron Deposits.

THE HARTVILLE DISTRICT.

The Hartville Iron District is the largest yet discovered in Wyoming and it is altogether probable that it will be the first smelting center. This district extends from the Platte River on the south northeastward to Whalen Canon and is from two to three miles in width. The iron ore occurs in irregular zones in carboniferous rocks, associated in many instances with large and valuable copper deposits. The Sunrise mine, which has been extensively worked for copper, is now the leading iron mine in the camp. It is claimed on good authority that this mine has 500,000 tons of hematite ore in sight. There are now lolated and under the control of a company about 100 claims of twenty acres each, all of which show good bodies of high-grade, pure hematite. The company controling the camp has purchased a large tract of land in the Platte River where water power can be utilized. There is ample wood for mining purposes and an abundance of limestone for flux. Should the Weston County coal prove a coking coal low enough in sulphur to make a good grade of pig iron its nearness to this camp would prove very beneficial.

I append here some analyses made from the ores of the Sunrise and Chicago claims by H. B. Hodges, chemist for the Union Pacific Railroad:

Analyses of Iron Ores From the Sunrise and Chicago Iron Mines, Hartville. Wyoming.

CONSTITUENTS.	SUNRISE SURFACE ORE.	SUNRISE DUMP SAMPLE.	HARD ORE SAMPLE 90 FEET OF LOWER LEVEL.	SOFT SAMPLE 90 FEET FROM BOTTOM LEVEL.	CHICAGO.	CHICAGO.
Silica	2.40	1.90	....	13.03	9.12	11.86
Ferric oxide	94.42	96.50	88.45	83.65	89.08	83.03
Phosphorus	.07	Trace.	0.02	Trace.	Trace.	Trace.
Titanic acid	None.	None.	None.	Trace.	None.	None.
Copper	None.	None.	None.	Trace.	None.	None.
Metallic iron	66.09	67.55	61.92	58.56	62.35	58.75
Calcic oxide	....	....	....	....	....	1.17
Sulphur	None.	None.	None.	Trace.	None.	None.
Water	....	....	0.47	0.25	0.35	0.33

The above analyses warrants one in saying that no camp in the United States can show a higher grade class of ores.

Albany County Iron Deposits.

IRON MOUNTAIN.

Iron Mountain is located at the head of a branch of Chugwater Creek in the eastern and central portion of Albany County. This iron mountain is the largest single mass of ore in Wyoming. The ore is chiefly an ilmenite, carrying a high percentage of titanic acid which makes it valueless for the production of metallic iron. Some process may be invented that will separate the injurious element and make it valuable, but such does not exist today.

ANAYSIS OF IRON MOUNTAIN IRON ORE.

Ferric oxide	47.21
Ferrous oxide	25.80
Titanic acid	22.43
Sulphur	1.14
Silica	1.21
Other elements not estimated	——

CHROME IRON.

At the head of Dutton Creek there is a deposit of chrome iron ore occurring in a mica schist. I am unacquainted with the locality and do not know its extent. The ore has been analyzed in Denver and New York, but

I am unable to secure the analyses and have no time to make one.

There are deposits of micaceous iron in the Laramie Hills near Laramie Peak, but they have never been prospected. There is also a large deposit of iron in Jelm Mountain which contains 52.60 per cent of metallic iron.

In the Cretaceous rock in what was termed Ft. Benton shales, but is now included in the Colorado group, there occur beds and irregular masses of clay ironstone. It is not known whether or not these beds, which are very extensive in Wyoming, have any commercial value. Large beds of this iron have been located in Crook county, but as far as my investigation went during the past summer the deposits are too thin for economic work. I append here an analysis of this class of ore taken from the Fortieth Parallel Survey, Vol. I., analysis No. 120, plate preceding page 543. Analyst, B. E. Brewster:

Silica	9.74	per cent
Aluminum oxide	5.57	"
Ferrous oxide	38.67	"
Ferric oxide	1.93	"
Calcium oxide	7.64	"
Magnesium oxide	1.20	"
Sodium } Potassium } oxide	0.46	"
Carbonic dioxide	32.04	"
Manganese oxide	2.38	"

Fremont County Iron Ore.

A deposit of red hematite ore was discovered by a man named Plant in 1888 some thirty or forty miles west of Lander. The ore was high grade, free from injurious compounds, and assayed 60.40 per cent metallic iron. South of Atlantic City a few miles there is a bed of siderite. Neither of the above discoveries have received any attention by people looking for iron ore. Along the east flank of the Wind River Mountains there are many

pieces of magnetite found which indicate large bodies of iron ore in the range.

Throughout the state but little attention has been paid to iron ore, for as the prospector often remarks, "I want something I can get money out of and not be compelled to live all my life in the mountains in waiting." The construction of the railroads into the mineral localities of the state will soon cause the iron mines to be eagerly sought for.

The Wyoming Soda Lakes.

Albany County.

There are three localities in Albany County where valuable soda lakes or deposits exist, which are as follows: The Union Pacific lakes, thirteen miles southwest of Laramie; the Downey lakes, which are twenty miles southwest of Laramie, and the Rock Creek lakes, which are twelve miles northwest of Rock Creek station. These lakes occur in depressions in Mesozoic rocks, which have an inlet but no outlet. The chemical composition of the sodium sulphate taken from them is practically the same. There has been much speculation as to the source of this soda compound, but no definite explanation can be offered here. It is believed by some that the soda is brought in by the water from the country draining into the lake; by others that it is brought from other sources by the aid of springs. Both of these propositions are tenable, and I am inclined to believe that both are right. For the last two years I have paid special attention to this subject and have investigated both sides. That soda sulphate exists in a great many clays and marls of the Cretaceous formation needs no proof. Those who have observed fields in many localities irrigated, have seen the vegetation cov-

ered with the salt, and further, the small pools or ponds into which such water drains contains sodium sulphate in considerable quantity. St. James' Lake, Cooper Lake. Hutton's Lake, and in fact every pond of water on the Laramie Plains, contains more or less of this sodium compound in solution. I believe that the lakes which contain crystalline deposits are and have been reservoirs fed by streams of water which pass through clays or marls rich in this salt. These lakes may also be fed by springs. While examining the Downey lakes I sank several holes through the deposit. When the black mud was reached, which is common to all the soda lakes, water of a yellowish color commenced to seep in and in the course of a half hour the hole was full. The amount of water filling these excavations was carefully measured and found to be seeping in at the rate of 450 gallons per hour. This solution was super-saturated and had a gravity of 31°, Baume. Upon analysis it was found to contain 75.836 per cent of sodium sulphate, $Na_2 SO_4 + 10$ Aq. Using the above for a basis to estimate, one of these seeps would produce every twenty-four hours two and one-half tons of anhydrous salt. I am not prepared to say that the water comes from springs, for it may be a mere seepage from the salt deposit in the lake and from the country round about; yet the evidence is strongly in favor of springs underlying the deposit. The only question necessary to settle is whether or not the influx of water into the pits sunk through the deposit would be constant, or whether it might be of only a few weeks or even months duration. This question is of vital importance to the owners of the soda deposits in the state, for if the deposits are fed by springs the amount of soda to be extracted from the various lakes in the state is beyond calculation.

In less than six months these holes were entirely filled with newly crystallized sodium sulphate. In no instance have I seen any evidence of springs above the shore line of the lakes. Near the Downey lakes there has been an artesian well drilled which flows a good stream of com-

paratively pure water. The supply of sodium sulphate in these lakes is practically inexhaustible, for the deposits are continually accumulating more soda. There has been taken from the Union Pacific lakes 10,000 tons of the salt, and from all appearances the lake contains as much as ever.

The Downey lakes are about 100 acres in extent and are covered with a deposit of crystalline sodium sulphate varying in thickness from a few inches to several feet. The deposit is not clear, being interlaid with streaks of dirt and some sand which has blown in while deposition was in progress. The product from these lakes has never been utilized.

The Union Pacific lakes cover an area of 60 acres. The deposit on these lakes is claimed to be over twelve feet in thickness. At one time a cube 8x8x8 feet was taken out in one piece. The Union Pacific has a branch road constructed to these lakes. The soda is hauled to Laramie to the chemical works, where it is calcined and shipped east for glass making. Some years since it was manufactured into caustic and carbonate compounds, but the plant is now idle. The calcined product has been largely used at Laramie for glass making. This compound of soda is supplanting the carbonate in glass manufacturing.

The lakes at Rock Creek are located with those containing magnesium sulphate, and are very small compared with the others in Albany County.

Carbon County Soda Lakes.

Soda lakes are more numerous in Carbon County than in Albany. Lakes have been located at the following places: Thirty miles northwest of Rawlins by Mr. Bothwell; five miles northwest of Brown's Canon by James Rankin; at Saratoga by unknown parties; in the northeastern part of the county by D. W. Gill.

Dr. Ricketts estimated the area of the Bothwell lake at 100 acres, but did not give a detailed report. The locality could not be visited this season.

The Gill lakes are described by Dr. Ricketts as follows: "This group of lakes is situated in section 26, township 25 N., range 78 W., and is six miles north of the Platte River at the old Fiddleback Ranch. * * * They are four in number and are located in claims of 160 acres each. Of this area 80 or 90 acres are covered by the lakes. A number of pits have been sunk to a depth of twelve feet on these lakes, and from one of this depth a hole was bored four feet deeper. The soda has never been pierced."

The product from these lakes is a sulphate of sodium.

The Rankin lakes are small but contain a high grade sodium sulphate.

There are several soda deposits located between Saratoga and Elk Mountain. The quantity of the soda in these deposits is not known to me. The quality resembles the other sulphates found in Albany and Carbon counties.

Natrona County Soda Lakes.*

The Natrona County soda deposits, with the exception of the Morgan lake, differ greatly in composition from those found in other parts of the state, the salt of these deposits being composed of sulphate, carbonate, bicarbonate and chloride of sodium.

The Morgan lake is located in the southwestern corner of Natrona county, on the south side of the Sweetwater river. In August, 1888, this deposit was examined, but owing to the large amount of water no definite estimate could be made. The deposit seemed to have bars of solid soda extending in various directions, the thickness of which were not determined. The soda taken from this lake is a pure sulphate, containing no substance detri-

*The term lake is used, since the surface of these deposits is a sheet of water during several months of the year.

mental to the manufacture of soda compounds or glass making.

The largest area of soda deposits in Natrona County is controlled by the Dupont Company or their successors. This group comprises 300 acres of soda deposit, and the claims are known under the following names: Omaha, New York, Philadelphia, Wilmington and Wilkes-Barre. The product taken from these lakes contains variable proportions of sodium salts. The surface deposit contains a large percentage of carbonate and bicarbonate of soda, but with depth the carbonates are gradually replaced by the sulphate. The soda from these lakes is not utilized.

North of the Dupont lakes the Syndicate Improvement Company owns a few deposits, the extent of which are not known. This company erected a soda plant last year, but were unsuccessful in the manufacture of soda compounds. The salts found in their lakes are, on the whole, the same as found in the Dupont.

Soda lakes are reported from Fremont, Johnson and Sweetwater Counties, but as far as investigation has gone none of them have a commercial value.

The utilization of the natural sulphate of sodium for the manufacture of sodium compounds has not been successful in Wyoming, the great stumbling block having been the liberation of the water of crystallization. The Laramie Chemical works erected large reverbatory furnaces with small iron pots sunken in the floor, but this was found too expensive. A series of experiments have been conducted in the University to determine the cheapest method of driving off the water from the natural product. These experiments have been successful and during the coming year will be presented to the public. There is no apparent reason why these valuable deposits of soda cannot be utilized and made to take the place of a large percentage of imported product.

Analyses of Some of the Soda Deposits of Wyoming.

NAME OF CLAIM.	COUNTY.	NUMBER.	WATER.	CHLORIDE OF SODIUM.	SULPHATE OF SODIUM.	CARBONATE OF SODIUM.	BICARBONATE OF SODIUM.	INSOLUBLE.	REMARKS.
New York and Philadelphia.	Natrona...	1	....	1.85	71.37	3.10	....	22.85	U. S. Mineral Resources, 1885.
		2	....	2.04	44.77	5.00	....	47.50	
		3	....	2.52	72.40	5.10	....	19.03	
Wellington..................	"	1	....	1.83	39.04	59.00	....	9.23	" " "
Wilkes-Barre..............	"	1				*37.28			" " "
		2	....	....	....	*49.00	....	....	
Omaha....................	"	....	9.01	2.13	25.75	30.62	30.00	2.61	" " "
Gill..........................	Carbon....	....	1.61	0.54	94.50	Mg. Sulphate. 2.52	....	....	By L. D Ricketts.
Rankin.....................	" ...	....	39.52	4.41	42.51	....	....	10.52	....
Downey.....................	Albany....	....	54.60	....	45.17	....	....	0.08	....
Union Pacific...............	"	....	55.83	....	44.03	0.04	....	0.10	Analyst unknown.

*Grains per gallon.

Magnesium Deposits.

ALBANY COUNTY.

The only valuable magnesium mineral yet discovered in the state is epsomite or Epsom salts. This deposit is located three miles north of Wilcox station on the Union Pacific Railroad, in Albany County, and consists of several lakes, the largest of which is the Brooklyn. This lake has an area of ninety acres and is covered with a deposit of pure Epsom salts. This with the several adjoining lakes contains enough Epsom salts of commercial purity to control the Epsom salt trade of the world, but the existing high railroad tariff to eastern markets makes it impossible to utilize this natural product. Some enterprising company might erect a plant and convert it into other magnesium compounds that would be of sufficient value to export to the east. Coal and good limestone are located near the deposit and building material is by no means dear.

The following is an analysis of this salt:

Insoluble residue	0.08
*Magnesium sulphate	51.22
Water	47.83
Chloride of sodium, calcium and magnesium	0.42
Iron	Trace
Loss	0.45

*The magnesium sulphate as here estimated contains a very small percentage of calcium and sodium sulphates.

Mineral Paints.

The hematite iron deposits north of Rawlins contain large amounts of ore which has a deep red color and has been manufactured into paint for many years. Small companies have at various times tried to manufacture paint at Rawlins, but they have never succeeded. The Union Pacific Railroad has utilized this product for years for painting cars. In 1884 F. W. Dove & Co., of New York, ad-

vertised this paint as Rocky Mountain Vermilion and sold large amounts to the elevated railroads of New York and Brooklyn. A new company has been organized to operate a paint mill at Rawlins. This paint is one of the strongest iron paints known in the United States. The Hallock Paint Company, of Denver, have been mining the same kind of ore from the Dillon claim and shipping it to Denver to be ground. No record has been kept of the output of paint ore from either of these mines, unless perchance it can be obtained from the railroad company.

At Hartville, Laramie County, there are many deposits of soft hematite which makes a superior paint. The Lincoln Paint Company examined these deposits in 1887 and found the quality and quantity satisfactory, but owing to a twelve mile haul by wagon they could not ship these ores to Lincoln and compete with those from Wisconsin and Tennessee.

Near Evanston there is a deposit which is called paint rock, the composition of which I have not learned. A company commenced the manufacture of paint at this place in 1890, but whether successful or not I am unable to say. The rock as mined was found in various colors, varying from black to brown and a light to a dark red.

Paint rock is also found in Crook and Fremont Counties, but no attempt has been made to utilize them.

Ochers of various shades have been found in Albany County forty miles northeast of Laramie. This deposit has been known for several years, but has never been developed. Ochers are also reported from Fremont and Carbon Counties.

During the last ten years there has been a great deal of experimental work done in searching for a fire-proof paint. The best results have been obtained from paints manufactured from asbestus and graphite, both of which are found in many counties in Wyoming.

Asbestus.

Asbestus has not been known in Wyoming until quite recently. The first discovery was made east of the Seminoe Mountains in 1881. Since then deposits have been discovered at Laramie Peak, Casper Mountain, on Grand Encampment River and in the Wind River and Big Horn Mountains. The Casper deposit is the only one sufficiently near the railroad to warrant any extensive development.

The Laramie Peak asbestus is located thirty miles northeast of Rock Creek Station, on the north fork of the Laramie River. The serpentine in which it is found covers an area of 200 or 300 acres. Asbestus is scattered throughout the county rock, the seams ranging from an inch to a foot in width. The property has been partly developed and shows many varieties of mineral, but none of the fine silky asbestus with tough fiber which is utilized for wearing. Samples have been submitted to eastern manufacturers who offered from $20 to $35 per ton for the mineral delivered in New York. The best quality of the mineral found was in narrow veins which had undergone a secondary movement and had crushed and rolled the asbestus into bunches.

In Carbon County asbestus has been found on the Grand Encampment and in the Seminoe Mountains. The Grand Encampment samples desplayed have a long white fiber, but seem to be quite fragile. The samples were taken from the surface. The mineral taken from a depth may be much superior. There is no development on this property, which is twenty-five miles southwest of Saratoga.

The asbestus found on the east side of the Seminoe Mountains is a low grade, approaching the actinolites. The district has not been thoroughly prospected and a better grade may yet be found.

Asbestus was discovered on Casper Mountain, twelve miles south of Casper, in Natrona County, about three

years ago. The mountain is composed of serpentine, which is flanked on all sides with sedimentary rock. In an area of country of two and one-half by three miles there are numerous places where asbestus has been found. The development is very meager with the exception of one or two places which were under lock and key. The asbestus displayed as samples was of short fiber and had a leek green color. The fiber was rather ridged and not sufficiently fine for wearing purposes. An eastern company purchased one of the most promising claims, mined and shipped a carload of mineral, but the result of the operation has been kept a secret. This is the most extensive asbestus camp known in the state. The matter of judging the quality of the mineral produced is a difficult one and had better be referred to the eastern markets where quotations on asbestus are cheerfully given.

Plumbago.

Plumbago has been discovered in all the mountain ranges of the state, but as yet none of the districts have been thoroughly prospected.

In Albany County, twenty-seven miles northeast of Laramie, there is a large district known as Plumbago Canon where there are a great many deposist of plumbago. From Plumbago Canon north and east for twenty miles, to Hallàc Canon plumbago also occurs. The only pretense toward development has been at Plumbago Canon, where a few shallow shafts and short tunnels were made about twenty years ago. The ore found was not sufficiently pure nor in bodies large enough to pay for working unless some machinery was put in to remove silica and other detrimental compounds.

In the examination of these deposits some narrow seams of very pure graphite were found and large bodies associated with iron sulphide and silica. Some of these will no doubt be worked for plumbago in the near future.

The Fremont County plumbago occurs near Miners' Delight. G. C. Nickerson, of Lander, claims the deposit to be very extensive and very pure.

Owing to the large consumption of plumbago in the United States, which amounts to 16,000,000 pounds per annum, some of these deposits should soon become a source of revenue to some enterprising company. The annual production of the United States is not to exceed 500,000 pounds, the only large plant for dressing the ore being located at Ticonderoga, New York. American graphite is worth, when pure enough to manufacture from, four to seven cents per pound, which is two cents more than is paid for the imported Ceylon. These figures should be very encouraging to those anticipating the working of plumbago mines.

ANALYSIS OF PLUMBAGO FROM PLUMBAGO CANON, ALBANY COUNTY, BY R. W. WOODWARD.

Graphite	51.35
Aluminium	11.55
Ferrous oxide	1.71
Manganese oxide	1.24
Lime	1.44
Magnesia	3.21
Sulphur	1.09
Silica	24.59
Water	4.38
Oxygen = to $Fe\ S_2$	.27

Gypsum.

Is very abundant in every county in the state, the quality varying from type crystalline forms to large beds of amorphous mineral ranging in thickness from two to twenty-five feet.

The only place where this mineral is utilized is at Red Buttes, Albany County, where a company is operating a plant for the manufacture of plaster of Paris. This product is shipped westward to the Pacific Coast and also to eastern and southern markets.

PLASTER OF PARIS OUTPUT, ESTIMATED.

1889, commenced operation in November	500 tons
1890	800 "
1891	1,100 "
1892	1,400 "

The gypsum utilized by this company is an amorphous variety occurring in Triassic rocks. A sample from this bed gave the following analysis:

Sulphate of lime	75.04
Water	20.81
Silica	2.87
Oxide of iron	1.54

In Crook County, northeast of Sundance, there is a deposit of crystalline gypsum of considerable extent. It occurs in huge slas of considerable thickness. Pieces two by three feet and from four to six inches thick are commonly taken away as specimens. This deposit will be of great value, as soon as within the reach of transportation, for the manufacture of high grade plaster of Paris.

Mica.

While mica is found associated with various minerals throughout the state, there are only a few localities where it may occur in quantity sufficiently large to be of commercial value. On the east side of Whalen Canon, Laramie County, there are many ledges of feldspathic granite from six to fifteen feet in width, through which are scattered crystals or books of mica. In 1880 some prospecting was done on these ledges and a small amount of mica shipped east. Since then there has been no extensive work done. The mica is clear, water color, tough and cuts in sizes as large as 6x8 inches. Considerable development is necessary to determine the value of these veins.

There are also deposits or veins in Albany, Crook and Fremont Counties, which have not been prospected to any great extent.

Bismuth.

A very high grade bismuth ore was discovered on Jelm Mountain, Albany County, a number of years ago. Several hundred pounds of this mineral was shipped east. For some reason the property has not been very productive, although masses of ore weighing several hundred pounds were often taken out during development. The ore is a carbonate of bismuth containing metallic particles of the same mineral. Assays vary from 60 to 80 per cent bismuth.

Arsenic.

The only valuable arsenic ore known in the state, in any quantity, is Mispickel. This ore is very abundant in the Black Hills and Medicine Bow Range, but no attempt has been made to utilize it.

Infusorial Earth.

Extensive deposits of infusorial earth are reported from Crook County, but nothing definite regarding the locality or quality is known.

Alum.

A deposit of alum of commercial importance is reported from Crook County. Exact data relating to this prospect could not be obtained.

In Fremont County, on Table Mountain, a deposit containing alum was discovered some years ago. A sample sent east for analysis* contained about 12 per cent of alum. Samples were to be sent to the University for

*Analysis was furnished by James McAvoy.

analysis for this report, but up to the time of going to press they had not arrived.

Brick Clays.

Clay banks intervening between loess and rock in place, such as are common in the central states, are not found in Wyoming. Building brick of an inferior grade have been made in all the towns and cities in the state from loess, which renders them so silicious and friable as to be of little consequence for heavy work. There are clay banks in nearly every county, but they are found in the sedimentary rocks, and no brick maker has seen fit to attempt the manufacture of brick from clay.

The Cambria Coal Company, at Cambria, have discovered an extensive bank of superior clay beneath their coal mines, from which they have had a few bricks made. They are a light red color, very firm and dense, capable of standing in any wall, and are the only first-class brick that have been made from Wyoming clay.

Fire Clays.

Associated with Triassic, Jurassic and Cretaceous formations throughout the state are large beds of fire clay. But little attention has been paid to their development, and none of them have been utilized for manufacturing fire clay goods. But few of these clays have been analyzed; in consequence one is not warranted in passing judgment. Clays found in the Cretaceous of Colorado are manufactured into a great variety of fire clay goods which are equal to any foreign make. It is only reasonable to expect that the Wyoming clays when tested will prove of equal quality. The industry, however, cannot amount to much until manufacturing interests are developed within

the borders of the state that will demand a large quantity of fire clay goods.

At Rock Creek station, on the Union Pacific railroad, a bank of clay has been opened and several carloads shipped to New York to be utilized in the manufacture of paper. This clay would make a medium grade fire brick, but contains too much iron to be first-class.

In Crook County, west of Sundance, a bank of clay has been discovered in Cretaceous rocks which has been called mineral soap or Saponite. The clay when moistened has an unctuous feeling resembling soap; but in chemical constituents it could not be classed as a mineral soap. This clay also has a larger percentage of iron and lime than can be utilized in the manufacture of fire clay goods that have to withstand high temperatures as in connection with smelting and refining plants.

Analyses of Rock Creek and Crook County Clay With Analyses of Stourbridge Clay and Saponite for Comparison.

The Crook County clay was analyzed by H. Westphal, of Philadelphia. The analyst of the Rock Creek clay is not known.

	Analysis of Stourbridge* clay for comparison.	Analysis of the Rock Creek clay.	Analysis of the Crook County clay.	Analysis of Saponite† or mineral soap.
Oxide of silicon	65.10	59.78	61.08	42.13
" aluminum	22.20	15.10	17.12	7.25
" manganese	0.18	4.14	1.82	19.33
" lime	0.14	0.73	2.69	0.80
" potash	0.18	......	......	0.58
" iron	1.92	2.40	3.17	‡6.89
" sodium	......	......	0.20	2.09
Water	9.28	16.26	12.10	21.07
Organic matter	0.58	......	......	......
Phosphoric acid	0.06	......	......	......
Sulphuric acid	......	......	0.88	......
Oxide manganese	......	......	Trace.	0.13

*See Thorpe's Dictionary Applied Chemistry.
†See Dana's Manual of Mineralogy.
‡Includes Ferric and Ferrous oxide of iron.

Building Stone.

Unlike the states of Kansas and Nebraska, every county in Wyoming is supplied with a great variety of building stone. As yet but few quarries have been opened, but everywhere we hear of the beautiful granites, sandstones, limestones and marbles. Along the line of the Union Pacific Railroad there are many idle quarries, simply because the companies owning them cannot quarry and ship building stone to Nebraska in competition with the large stone interests in Colorado. The Rawlins quarries, which are the finest yet opened in the state, have been shut down for a long time for the want of a switch three miles long so that they can load directly on the cars. Mr. McPherson, who has had charge of the Rawlins quarries for a good many years, tells me that there has been shipped into Nebraska and a few other points 1,000 car loads of stone, which would average 250 cubic feet to the car. He further said that the stone was valued at 45 cents per cubic foot, f. o. b., which would make the gross output of the Rawlins quarries $112,500. This sandstone has a soft gray color, is firm, regular in texture and is free from flaws and water seams. It can be quarried in any sized blocks desired and cuts very free under the chisel. The crushing strength varies from 8,000 to 10,000 pounds per cubic inch.

In Albany County there are quarries of various colored sandstones, limestones and granites from which some stone has been shipped to eastern points. The Sherman granite is one of rare beauty and utility.

North of Cheyenne, in Laramie County, are numerous quarries of sandstone which are worked in the interests of local consumption. These sandstones are very solid, fine grained and make a first-class building material. They range in color from a light gray to a dark red.

Along the Northwestern and Burlington Railroads there are numerous quarries, some of which are shipping stone into Nebraska. Besides these there is not a town or

hamlet in the state but has its own stone quarry. The stone industry of Colorado in 1890 amounted to $1,750,000.00 while the quarries of Wyoming were idle. All that is needed to make the stone industry of Wyoming is a railroad rate that will allow the shipment of building material into Nebraska in competition with those of Colorado.

Marbles.

Marbles are very common throughout the state, but since they are a long distance from any railroad no attempt has been made to develop them sufficiently to prove their value. These marbles are generally found in Carboniferous rocks, which flank many of the principal ranges in the state.

In Laramie County marbles occur in the northern part of the Hartville Mining District and from thence to Rawhide Buttes. The surface marbles are badly fractured by erosive agencies and no workable seams have been exposed. Some beautiful specimens have been cut and polished and show marbles of very high grade. In color they vary from a pure white to a dark brown; take a high polish and are hard enough to be valuable for building and ornamental purposes.

Twelve miles west of Uva, on the Cheyenne and Northern Railroad, there is a large deposit of Dolomitic marble, which will make a very valuable building stone. Owing to its silicious nature it will withstand weather much better than a pure marble. This dolomite is free from seams and irregularities and varies in color from white to a dull gray.

At Plumbago Canon, Albany County, there is a large ledge of marbles of various colors, but like other deposits it has not been developed. Large specimens are on exhibition in Laramie showing it to be a fine-grained stone capable of a high polish.

Near Douglas, Converse County, there is a large bed

of red marble. The samples displayed in Cheyenne in 1888 were all superior grades and would make an excellent ornamental stone.

Extensive marble beds flank the Wind River range in Fremont and Big Horn Counties and the Big Horn Mountains in Johnson and Sheridan Counties. Probably these beds are the largest and most important in the state.

ANALYSIS OF LARAMIE COUNTY DOLOMITIC MARBLE.

Calcium carbonate	50.76
Magnesium carbonate	41.26
Silica	7.15
Water	0.33
Iron	Trace
Loss	0.14

Mineral Springs.

Mineral springs are numerous in the state outside of the Yellowstone Park. But few of them, however, are generally known, since they are in inaccessible places and long distances from the railroads. Warm mineral springs are the first to attract attention, as they usually contain medicinal properties.

One of the largest mineral springs of the state is located near Fort Washakie,.and is utilized by Indians and white people for bathing. These springs are neutral but contain lime, magnesia and soda as sulphates and chlorides. They are reputed to cure rheumatism and all kinds of skin diseases. They are similar in effect and composition to the *Aix-les-Bains* (Savoy) authority, C. L. Heizman. The average temperature of the water is 106° F.

At Saratoga, Carbon County, there are a number of warm springs ranging in temperature from 90° to 120° F. These springs are neutral and contain salts of calcium, sodium, magnesium and iron. A large hotel and bath house are maintained, which are liberally patronized, considering that they are twenty-five miles away from the

railroad. The people who have been treated for rheumatism and general debility at these springs speak of them in highest terms.

At the mouth of the Grand Canon of the Platte, in Natrona County, there are a number of warm springs with temperatures varying from 98° to 142° F. These springs are controlled by an incorporated company, who intend to build a large hotel and bath houses. The anticipated railroad going up the Platte river will encourage this enterprise very much, since the line will pass the springs.

Warm mineral springs are found in great numbers along the Stinkingwater River and in the Wind River Mountains, with temperatures ranging from 60° to 70° F. There is also one in Beaver Canon with a temperature of 90° F., and many along the Big Horn River.

At the head of the Big Horn Canon on the Shoshone Reservation there is a large spring that is visited by people from great distances. It is not an uncommon thing to have patients arrive who have been hauled in a wagon one or two hundred miles. The people of northern and central Wyoming cannot speak in terms of too high recommendation of these springs. They have not undergone a critical examination.

Cold mineral springs are more numerous than warm ones, being found in nearly all the mountain ranges in the state, but no attention has been paid to their chemical compositions nor their exact localities.

The University will analyze free of charge any mineral water of importance in the state, if the sample is taken according to directions, which will be sent on application.

Sulphur.

Native sulphur is found in Uinta, Fremont and Big Horn Counties. The Uinta deposits, for there are two, are located thirty miles south of Evanston and on Salt Creek, in the western-central part of the county. These deposits

are a long way from transportation and have thus far not been considered of any importance. Sulphur is also found in the Wind River Mountains, but the exact locality is not known.

Manganese.

The most valuable deposit known in Wyoming has been located in the Bear Lodge Mountains about ten miles north of Sundance. The locality was not examined, but judging from the massive samples displayed in Sundance the property must be quite extensive. The ore is a black oxide of manganese, nearly pure, and assays 57.55 per cent of binoxide of manganese.

In the northwestern portion of Albany county there is a large deposit of silicious manganese that has not been considered of any commercial value. A sample of this ore assayed 68.41 per cent binoxide of manganese.

Agates and Semi-Precious Stones.

Agates, especially moss agates, are very common in Wyoming, and many of them are of rare beauty. Large quantities have been collected and shipped out of the state as specimens and to be cut for ornamental purposes.

Pebble agates found in Natrona County are the most valuable, since they contain tree-like moss (an oxide of manganese.

Throughout the state there are found a great many varieties of agate, shading from jaspers to chalcedonies. Banded agates are not common, although found in some localities. Agatized wood is very plentiful and found in a great variety of colors. Jaspers and chalcedonies are very common, but have no commercial value.

Quartz crystals, smoky quartz, amethysts and opals occur in various localities, but none of them are mined or utilized for other purposes than specimens.

Glass Making.

There are many industries of great importance to Wyoming outside of the coal, iron and petroleum. One worthy of special mention is that of glass making. It is altogether probable that Wyoming is the only state in the Union where all the materials necessary for the manufacture of glass are found in the natural state and in large quantities closely associated. As far as known limestone, sand and coal are found in the same vicinities with the soda.

The manufacture of glass in Wyoming is no experiment, for the Laramie Glass Works have already produced several thousand tons. The company operating this plant was composed of western men who have had no experience in glass making, with but small capital, and were not able with an old-fashioned plant to compete with the long established glass makers of the eastern and central states. While the glass plant was in operation the various materials consumed were furnished laid down at the works for the following prices:

Carbonate of lime	$ .90	per ton, 2,000 lbs.
Sand (unwashed)	.90	" "
Sodium sulphate	10.00	" "
Slack coal (extra quality)	1.25	" "

The limestone was hauled about two miles down grade. It occurs in Carboniferous rocks and is remarkably pure. The following is an analysis. The author, however, is unknown:

Calcium carbonate	98.83	per cent.
Magnesium carbonate	0.45	"
Iron carbonate	.02	"
Iron bisulphide	.10	"
Alumina	.43	"
Silica	.05	"

The sandstone is quarried near the lime and comes from the same geological horizon. It is very pure and fine, containing only a trace in iron and a very small percentage of organic matter. These materials can be quar-

ried and furnished to a glass plant for a less figure than the Laramie Glass Company paid for them. In quantity they are inexhaustible.

The soda used was a sulphate that occurs in large deposits south and west of Laramie. This compound should cost very much less than that from any other source in the United States. It has been taken from the deposit in 1,000-ton lots for fifty cents per ton. All that is necessary to prepare the crude sulphate for glass making is to calcine it. The pure crystals taken from the surface of the lake contain a large percentage of water, but no impurities detrimental to glass making.

ANALYSES OF THE NATURAL SODIUM SULPHATE.

	Downey Lake.	*U. P. Lake.*
Sodium sulphate	45.17	44.03
Water	54.60	55.83
Insoluble	.08	.10
Carbonate of soda	——	.04

These analyses were made from the salt as taken from the lakes.

The slack coal used came from Rock Springs and is called the best cheap fuel known in the west. An analysis of the average run of coal from one of the Rock Springs mines is as follows:

Water	5.95	per cent.
Volatile matter	36.20	"
Fixed carbon	54.25	"
Ash	3.60	"

There is a large coal field only twenty-five miles from Laramie that has been partially prospected, and would furnish an abundance of fuel for any purpose. The quality of this coal is far below that of Rock Springs, but it is a fair fuel and might be utilized in a gas producer. Wyoming coal is now used in the Wheeler gas producer at Park City, Utah, where gas has supplanted wood for roasting ores.

**Analyses of the Laramie Coal.*

	Brown Coal.		Chase Coal.
	No. 1 Vein.	No. 2 Vein.	
Water	11.85	12.50	14.50
Volatile matter	34.65	38.50	34.50
Fixed carbon	47.30	40.95	44.75
Ash	6.20	8.05	6.25

*All analyses in this Bulletin not otherwise reported were made by Wilbur C. Knight, of the University.

These analyses were made from samples of coal taken from the mine and immediately analyzed.

Building material of all kinds are very reasonable throughout the state.

Any company desiring to investigate the field for glass making will find ample aid and liberal assistance from owners of the soda deposits and interested citizens. In this case Laramie has been given as an example for glass making because it has been tested there. The general remarks are applicable to the other localities in the state where natural products used in glass making are found.

A Catalogue of Wyoming Minerals.

The Territorial Geologist published in 1886 a Catalogue of Wyoming Minerals, but a large percentage enumerated in his catalogue do not exist in the state. The names and numbers used in this list are taken from Dana's Manual, 1892. It will be observed that many numbers in Dana's list are omitted. The reason for this is that minerals corresponding to the omitted numbers do not exist in Wyoming, or if they do they have not been found.

Native Elements.

GRAPHITE.

No. 1 (Dana No. 2.)—Plumbago Canon, Albany county; also in Fremont and Converse counties.

SULPHUR.

No. 2 (Dana No. 3.)—At Warm Springs on the Big Horn River and on the Salt River in Uinta county.

BISMUTH.

No. 3 (Dana No. 11.)—Fine metallic particles included in a carbonate of bismuth, Jelm Mountain, Albany county.

GOLD.

No. 4 (Dana No. 13.)—In placers and quartz veins of Albany, Carbon, Fremont, Johnson and Crook counties.

COPPER.

No. 5 (Dana No. 15.)—At Tie Siding, Albany county, it is found in rough masses, very pure, varying in weight from a few ounces to 200 pounds.

MERCURY.

No. 6 (Dana No. 16.)—Found at the King David mine, Silver Crown, on the 115 foot level.

PLATINUM.

No. 7. (Dana No. 22.)—Associated with gold in the placers of Douglas Creek, Albany county.

IRON.

No. 8 (Dana No. 25.)—Meteoric found in Laramie county, 1887.

REALGAR.

No. 9 (Dana No. 26.)—Fremont county..

ORPIMENT.

No. 10 (Dana No. 27.)—Fremont county.

Sulphides, Selenides, Tellurides, Arsenides and Antimonides.

MOLYBDENITE.

No. 11 (Dana No. 34.)—Associated with copper ores of Silver Crown, Laramie county; Big Horn Mountains, Johnson county.

ARGENTITE [SILVER GLANCE].

No. 12 (Dana No. 42.)—Running Water Creek, Converse county.

GALENA [SULPHIDE OF LEAD].

No. 13 (Dana No. 45.)—This valuable mineral is found in nearly every county in the state, but is not mined to any extent.

CHALCOCITE [COPPER GLANCE].

No. 14 (Dana No. 54.)—In Laramie, Albany, Carbon, Uinta, Fremont, Johnson, Crook and Natrona counties.

SPHALERITE [SULPHIDE OF ZINC].

No. 15 (Dana No. 58.)—Ferris Mountains, Carbon county.

MILLERITE [SULPHIDE OF NICKEL].

No. 16 (Dana No. 70.)—Reported from the Matilda Jane mine, Ferris Mountains, but not confirmed.

CHALCOPYRITE [COPPER PYRITES].

No. 17 (Dana No. 83.)—Common in all the mountain ranges of the state.

PYRITE [SULPHIDE OF IRON].

No. 18 (Dana No. 85.)—Very common.

ARSENOPYRITE [MISPICKEL].

No. 19 (Dana No. 98.)—Whalen Canon, Laramie county, and at the head of Rock Creek, Carbon county.

TETRAHEDRITE [GRAY COPPER].

No. 20 (Dana No. 148.)—In the mountains southwest of Saratoga, Carbon county.

Chlorides.

HALITE [COMMON SALT].

No. 21 (Dana No. 166.)—In Uinta, Fremont and Big Horn counties, in springs and streams.

CERARGYRITE [HORN-SILVER].

No. 22 (Dana No. 169.)—Black Buttes mine, Crook county.

Oxides.

QUARTZ.

No. 23 (Dana No. 210).

Vitrious Varieties.

1. Quartz crystals—Very fine crystals at Silver Crown, Laramie Peak, Red Desert and Amethyst Mountain.
3. Amethyst—Boulder Ridge, Albany County; Red Desert and Amethyst Mountain.
4. Rose quartz—Crook county.
6. Smoky quartz—Ordinary crystals at Plumbago Canon, Albany county.
7. Milky quartz—Very common.

Cryptocrystalline Varieties.

1. Chalcedony—Very common and in a great many varieties. Beautiful specimes of mammillary and stalactitic chalcedony are found in the northern part of Albany county, on Sheep Creek. Chalcedony geodes occur in Whalen Canon, Laramie county.
2. Carnelian—Sage Hen Creek, Natrona county.
3. Chrysoprase } In Fremont county and also near
4. Prase } Agate Lake Natrona county.
6. Agates—
   a. Banded—Inferior specimens are found in Fremont, Natrona and Albany counties.
   b. Clouded agates—Common in many localities.
   c. Moss agates—Beautiful pebble moss agates in Central Natrona county, on the Chugwater Creek, Laramie county, and common in many other localities; also a great variety of agatized wood.

9. Agate—Jasper—Bates' Hole, Carbon county.
11. Flint—Very common.
14. Jasper—Very common and in great variety.

OPAL.

No. 24 (Dana No. 212.)—Fremont, Natrona and Albany counties; also on the Snake River, Uinta county. No precious nor fine opals are found. Opalized wood common.

CUPRITE [OXIDE OF COPPER].

No. 25 (Dana No. 224.)—Copper King mine, Silver Crown, Laramie county; also on Rock Creek, Carbon county.

TENORITE [OXIDE OF COPPER].

No. 26 (Dana No. 230.)—Michigan and Sunrise mines, Laramie county.

CORUNDUM.

No. 27 (Dana No. 231.)—Wind River Mountains; exact locality not known.

HEMATITE.

No. 28 (Dana No. 232.)—Very common and in many varieties.

ILMENITE [TITANIC IRON].

No. 29 (Dana No. 233.)—Iron Mountain, Albany county.

MAGNETITE [MAGNETIC IRON].

No. 30 (Dana No. 237.)—Iron Mountain, Albany county, and Crook county.

CHROMITE [CHROME IRON].

No. 31 (Dana No. 241.)—Dutton Creek, Carbon county.

MINIUM [OXIDE OF LEAD].

No. 32 (Dana No. 244.)—Lenox mine, Silver Crown, Laramie county.

CASSITERITE [BLACK TIN].

No. 33 (Dana No. 248.)—Black Hills, Crook county.

PYROLUSITE [OXIDE OF MANGANESE].

No. 34 (Dana No. 254.)—Northern part of Albany county and Crook county.

Hydrous Oxides.

LIMONITE [OXIDE OF IRON].

No. 35 (Dana No. 259.)—Miners' Delight, Fremont county.

Carbonates.

A.—Anhydrous Carbonates.

CALCITE [LIME].

No. 36 (Dana No. 270.)—Varieties based chiefly upon crystallization and accidental impurities.

1. Dogtooth spar in beautiful crystals in Pliocene rocks south of Cold Springs, Laramie county. Nail head spar in perfect crystals in the Table Mountain cave, Laramie county.
2. Satin spar—In narrow seams in Carboniferous rock near Rock Creek, Carbon county.
3. Granular limestone—Common in Carboniferous rocks.
   Hard, compact limestone—Common in Carboniferous rocks.
   Lithographic stone—Vermillion Creek, Sweetwater county.
   Hydraulic limestone—Black Hills in Laramie county.

Tufa deposits from calcareous springs, streams or in caverns—

a. Stalactites—In the Table Mountain and Horse Creek Caves.

b. Stalagmites—Associated with stalactites.

c. Calc Tufa—Common about many springs.

Varieties based upon composition—

1. Dolomitic Calcite—East of Laramie three miles.

DOLOMITE.

No. 37 (Dana No. 271.)—Laramie county, twelve miles west of Uva. Good crystals found at Laramie Peak and Como, Albany county.

SIDERITE [CARBONATE OF IRON].

No. 38 (Dana No. 273.)—Common in Fremont, Big Horn, Albany and Carbon counties.

ARAGONITE.

No. 39 (Dana No. 277.)—Perfect crystals on Jelm Mountain, Albany county.

CERUSSITE.

No. 40 (Dana No. 281.)—Ferris Mountain, Carbon county; Black Hills, Crook county; Silver Crown, Laramie county.

BISMUTOSPHÆRITE [BISMUTH CARBONATE].

No. 41 (Dana No. 283.)—McMullen mine, Jelm Mountain, Albany county.

B.—Acid, Basic and Hydrous Carbonates.

MALACHITE [GREEN COPPER CARBONATE].

No. 42 (Dana No. 288.)—Very common. Good crystals in Sunrise mine, Hartville, Laramie county.

AZURITE [BLUE CARBONATE OF COPPER].

No. 43 (Dana No. 289.)—Also very common but massive.

TRONA [SODIUM CARBONATE].

No. 44 (Dana No. 299.)—Deposits in Sweetwater Valley, Natrona county.

Silicates.

A.—Anhydrous Silicates.

ORTHOCLASE.

No. 45 (Dana No. 313.)—Common in Primodal rock.

ANORTHOCLASE.

No. 46 (Dana No. 315.)—Obsidian Clifts, Fremont county.

ALBITE.

No. 47 (Dana No. 316.)—Black Hills and Medicine Bow Mountains.

OLIGOCLASE.

No. 48 (Dana No. 317.)—Laramie, Albany, Carbon and Fremont counties.

LABRADORITE.

No. 49 (Dana No. 319.)—Iron Mountain, Albany county.

LEUCITE.

No. 50 (Dana No. 321.)—Leuçite Hills, Sweetwater county.

PYROXENE.

No. 51 (Dana No. 325.)—Common in nearly all the mountain ranges.

AMPHIBOLE.

No. 52 (Dana No. 338.)—Common. Good crystals in Silver Crown, Laramie county.

1. Actinolite—Found associated with serpentines in several counties.
2. Asbestus—Occurs in Albany, Carbon and Natrona counties.

BERYL.

No. 53 (Dana No. 344.)—Large green crystals east of Whalen Canon, Laramie county.

GARNETS.

No. 54 (Dana No. 370.)—Common. Good crystals at Laramie Peak.

CRYSOLITE.

No. 55 (Dana No. 376.)—Near Fremont Peak, Fremont county.

FAYALITE.

No. 56 (Dana No. 377.)—Obsidian Clifts, Fremont county.

ZIRCON.

No. 57 (Dana No. 394.)—Fremont county, near Fort Washakie.

EPIDOTE.

No. 58 (Dana No. 407.)—Silver Crown, Laramie county; Devil's Gate, Natrona county.

TOURMALINE.

No. 59 (Dana No. 426.)—Double terminated black crystals. Whalen Canon, Laramie county.

STAUROLITE.

No. 60 (Dana No. 428.)—Whalen Canon, Laramie county. First mentioned by Dr. Ricketts.

B.—Hydrous Silicates.

MODENITE.

No. 65 (Dana No. 437.)—Very fine crystals Hoodoo Mountains, Big Horn county.

MUSCOVITE [COMMON MICA].

No. 62 (Dana No. 458.)—Whalen Canon, Laramie county; also in Albany, Fremont and Crook counties.

BIOTITE.

No. 63 (Dana No. 462.)—Very common.

SERPENTINE.

No. 64 (Dana No. 481.)—Carbon, Albany, Fremont and Natrona counties.

TALC.

No. 65 (Dana No. 484.)—Associated with veins of gold and silver.

SAPONITE.

No. 66 (Dana No. 488.)—Reported from Crook county.

KAOLINITE.

No. 67 (Dana No. 492.)—This mineral has been reported, but I have never seen any pure mineral. Under this division there occurs a large number of clays which have not, as yet, been classified.

CHRYSOCOLLA [SILICATE OF COPPER].

No. 68 (Dana No. 504.)—Hartville and Silver Crown, Laramie county.

Phosphates, Arsenides, Etc.

PYROMORPHITE.

No. 69 (Dana No. 550.)—Reported by Dr. Ricketts from Platte Canon Mining District.

OLIVENITE.

No. 70 (Dana No. 561.)—Essex Mountain, Fremont county.

SCORODITE.

No. 71 (Dana No. 607.)—Fremont county.

WAVELLITE.

No. 72 (Dana No. 639.)—Separation, Carbon county.

Borates.

BORAX.

No. 73 (Dana No. 707.)—Reported from Fremont county.

Sulphates, Chromates, Etc.

BARITE.

No. 74 (Dana No. 719.)—Red Desert, Sweetwater county.

MIRABILITE [SODIUM SULPHATE].

No. 75 (Dana No. 743.)—Common in Albany, Carbon and Natrona counties.

GYPSUM.

No. 76 (Dana No. 746.)—This mineral occurs in nearly all of the crystalline forms and is very common.

EPSOMITE [EPSOM SALTS].

No. 77 [Dana No. 748.]—Three miles north of Wilcox, Albany county, and Fremont county.

KALINITE [ALUM].

No. 78 [Dana No. 764.]—Crook and Fremont counties.

Molybdates.

WULFENITE.

No. 79 [Dana No. 818.]—Beautiful yellow crystals in the Lenox mine, Silver Crown, Laramie county.

Hydrocarbons.

Simple Hydrocarbons.

Ozocerite—Fremont county.

Oxygenated Hydrocarbons.

Succinite [amber]—Hanna coal mines; also in many other coal mines.

Petroleum—Very common.

Asphaltum—Found about the petroleum springs.

Bituminous coal—Weston county.

Lignite coal—General.

WYOMING MINERAL AWARDS

—AT—

WORLD'S FAIR, CHICAGO, 1893.

Name of Article.	*Exhibitor.*	*Locality.*
Iron Ore	Wyoming Railway & Iron Co.	Hartville.
Oil, collective exhibit from twenty-four localities	Wyoming State Board	Cheyenne.
Sulphate of Sodium, natural	S. W. Downey	Laramie.
Magnesia	S. W. Downey	Laramie.
Sulphate and Carbonate of Sodium	Wyoming Syndicate Improvement Co	Johnston.
Sulphate of Sodium	D. W. Gill	Cheyenne.
Sulphate of Sodium	E. S. N. Morgan	Cheyenne.
Sulphate of Sodium, natural	Stephen Padden & Co	Laramie.
Sulphate and Carbonate of Sodium	Wyoming Central Ass'n	Cheyenne.
Glass	Laramie Glass Works	Laramie.
Granite	S. W. Downey	Sherman.
Sandstone	Wyoming State Board and Twenty Others	Cheyenne.
Marble and Agate Mosaics	Wyoming State Board	Cheyenne.
Large Agates	A. W. McClure	Hartville.
Crystals of Calcite	Wyoming State Board	Cheyenne.
Fossil Fish	Wyoming State Board	Cheyenne.
Plaster of Paris	Red Buttes Plaster Mills	Red Buttes.
Copper Ore	Wyoming State Board	Cheyenne.
Gold Ore	" "	Crook Co.
Tin Ore	" "	Crook Co.
Stream Tin	" "	Crook Co.
Photographs of Geological Formations	" "	Cheyenne.

We are not able to announce at this date the results of the judges' examination of one of our principal exhibits, viz: coal, the complete awards in this class not having been as yet announced.

UNIVERSITY OF WYOMING.

Agricultural College Department.

WYOMING EXPERIMENT STATION,

LARAMIE, WYOMING.

BULLETIN NO. 15.

DECEMBER, 1893.

The Winter-Killing of Trees and Shrubs.

BY THE BOTANIST.

Bulletins will be sent free upon request. Address: Director Experiment Station, Laramie, Wyo.

WYOMING
Agricultural Experiment Station.

UNIVERSITY OF WYOMING.

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WYOMING UNIVERSITY EXPERIMENT GROUNDS,	THE HORTICULTURIST IN CHARGE

Introductory Note.

B. C. BUFFUM.

This bulletin is published to give, as briefly as possible, the results of work carried on by the Station in the sections of Agriculture, Horticulture and Meteorology not published elsewhere. It is largely a progress report. As the conditions of soil, climate and treatment unavoidably vary each year, none of the results given can be regarded final. It is thought, however, that they may be of interest and value as far as the present data indicate the adaptability of different varieties tested to the soil represented by each Experiment Farm. To make the work of the Experiment Station of immediate practical value to our people who are just beginning the change from the early range stock business of the west and extensive farming to smaller operations and intensive methods, we have been obliged to repeat much of the work already accomplished in other states, doing a large amount of general first work. In these initiative operations it has been necessary for the Station to establish the possibility of raising at all many of our common crops, without reference to special lines of technical work of interest to science.

The newness of fruit raising in the state has prevented our making reports upon varieties. Several years are necessary to furnish materials for observation before

we can get on our feet and be in a position to advance scientific horticulture.

All notes of value regarding crops raised on each of the Experiment Farms during the season of 1893, or crops, the yields of which were determined, are given in the following report upon Farm Crops and Garden Vegetables. The special test of onions, carried on the past season, will be repeated the coming summer and the results published in a future bulletin.

The results with grasses and forage plants were given in Bulletin No. 14, and are omitted from this report, with the exception of non-saccharine sorghums.

Prof. E. E. Slosson has prepared the article upon sugar beets, and I have been greatly assisted in the rest of the work by the superintendents of the Experiment Farms, who furnished special data, and Mr. Fred Nelson, assistant in Meteorology. Thanks are also due Mr. F. J. Niswander for carrying on the horticultural work on the Laramie Farm during my absence the past summer.

Crop Report for 1893.

B. C. BUFFUM.

The crops for the season of 1893 were not so heavy as usual in any part of the state. The unfavorable climatic conditions as given in the Meteorological section of this bulletin, in connection with the fact that in many places the necessary water for irrigation could not be obtained when most needed, are sufficient explanation of the causes. No satisfactory results were obtained on the Laramie Farm. The experiments will be repeated the coming season with little modification. Potatoes gave the most satisfactory results of the year. Careful experiments with this important product will be carried on at each of the Experiment farms alike for two or more years. The experiments in the cost and profit of growing wheat, and with flax, will be repeated, also, several seasons to verify results and determine the place and value of these crops in the state.

LARAMIE.

Of thirty-six varieties of farm crops planted. only the potatoes furnished any yield. The failures were general and due to the lack of water for irrigation from June 8 to 20, on account of the ditch being broken. The ground being unusually dry, water was needed at this time to germinate the seed and insure a crop. This with existing climatic conditions proved disastrous to the Laramie Farm. White Russian Wheat was ripening in places at

the time of frost but had been so stunted in its early growth that it was valueless. The ground was so dry that other varieties of wheat and oats, barley, rye, carrots and rutabagas either did not come up at all, or were retarded and destroyed soon after coming up. Some of the potatoes planted May 10, did not come up till June 26. The Early Maine, the first up, did not appear till June 2. All were irrigated twice in July, were frosted Sept. 9 and harvested Sept. 13 and 14. The fact that any yields were obtained under the circumstances points to the adaptability of this crop. No. 7, an unknown variety, gave 74.7 bushels to the acre. The last twelve varieties named in the table were grown in small quantities in the horticultural section. The yields are all small, but it must be borne in mind that no conclusions regarding the general yield of potatoes can be drawn from them. They are given to indicate the varieties which are apt to do the best under our conditions.

Potatoes.

Variety.	Planted.	Came Up.	Yield.
			Bushels.
1. Early Rose	May 10.	June 25	17 3
2. (Unknown)	"	" 19	37.4
3. Pride of America	"	" 22	11.7
4. Empire State	"	" 25	23.1
5. Mogul	"	" 26	26.6
6. (Unknown)	"	" 26	24.5
7. "	"	" 25	74.7
8. Polaris	"	" 20	11.2
9. Early Minnesota	"	" 26	33.6
10. Early Maine	"	" 2	21.0
11. *Early Ohio	May 16.	" 19	55.8
12. *Pink	"	....	59.4
13. *Beauty of Hebron	"	" 23	11.0
14. *California Rose	"	....	14.9
15. *Smooth-Blue	"	" 19	53.1
16. *Clark's No. 1	"	....	59.1
17. *Early Puritan	"	" 22	6.9
18. *White	"	....	43.3
19. *Early Minnesota	"	" 20	19.7
20. *Empire State	"	....	19.5
21. *White Elephant	"	....	27.6
22. *Snow Drop	"	" 27	27.7

*Grown in Horticultural Department.

LANDER.

The effects of the flood, which occurred in 1892, washing the top soil from the Lander Farm, are apparent in the yields of 1893. Much of the ground was foul with weeds, and some crops were plowed under to clear the land. The Red May winter wheat gave the largest yield, 23 bushels per acre. Twelve varieties of potatoes were grown, the larger part giving good yields. The heaviest yield was 314.3 bushels per acre, of Late Puritan. Pride of the West and Vanguard gave the poorest yields. The potatoes were irrigated four times, after the last, Aug. 21, several heavy rains occurred which kept the ground wet and prevented some varieties ripening. The same varieties of potatoes were grown on two different plats, each being treated the same. Plat 2 had the best soil and the yields were much larger than on plat 1. This plainly shows the effects of different soils in the same locality upon the crop, and the value of carefully selecting that most suitable for the crop to be grown.

Flint corn seems to grow and mature better in this locality than the dent varieties, but the grain is much inferior.

Crop Report of Lander Experiment Farm.

Crop.	Variety.	Yield.		Weight per bushel.	Remarks.
Wheat	Velvet Chaff	11	bushels	60	Shells out badly.
	Fultz Winter	12	"	62	Injured by west winds.
	Fulcaster	10	"	60	Injured by winds.
	Red May	23	"	62	" " "
Oats	Early Archangel	24¼	"	46	A fine, plump grain, and very early.
	Golden Giant	17½	"	40	A rough looking grain, not desirable for marketing.
Barley	New Black	. . .	. . .	. . .	Soil very weedy and yield poor; a part only threshed out for seed.
	Hulless	. . .	. . .	. . .	
	Manshury	9	"	. . .	Soil poor and weedy.
Rye	Winter	20⅓	"	56	No market in this locality.
Corn	Minnesota King	19 5-7	"	. . .	Did not all mature.
	Dakota Dent	22 1-9	"	. . .	" " " "
	Rideout, or Mercer	23 3-7	"	. . .	An early flint variety
	Cory Sweet	15	"	. . .	. . .
Peas	Frenchman Field	8	"	. . .	Much lost by wind scattering after cutting.
Beans	Boston Pea Field	188 pounds.		. . .	Kept too wet in irrigating.
		Plat 1.	Plat 2.		
		Bushels.	*Bushels.*		
Potatoes	Early Rose	221.8	. . .	. . .	Were kept too wet by rain after last irrigation.
	Vanguard	109	. . .	. . .	
	Beauty of Hebron	161.3	393.8	. . .	
	Empire State	256.2	378.3	. . .	
	Late Puritan	314.3	445.7	. . .	
	Early Puritan	211.7	539	. . .	
	Early Mayflower	251	480.7	. . .	
	Bill Nye	215.3	. . .	. . .	
	White Elephant	196.8	466.5	. . .	
	Snow Drop	242.7	425	. . .	
	Pride of the West	84	388.7	. . .	
	Jumbo	217.3	. . .	. . .	

SARATOGA.

With the exception of Polish wheat (called Mammoth rye, or Wild Goose rye), which yielded 21 bushels per acre, no farm crops matured sufficiently to obtain yields at Saratoga. Having water for but a small part of the farm, other varieties of wheat, oats, barley and rye were not planted. Seventeen varieties of potatoes were grown as given below and all yielded well. The largest yield was of the Blue Victor, which gave 313 bushels per acre. This is a late potato and a good keeper. The Chas. Downing gave the smallest yield, 148 bushels per acre. The late varieties were injured by the frost. In carrying out the experiments planned, all the varieties will be given further trial. Sorghum and broom corn were frosted Aug. 21, before maturing.

Saratoga.

Crop.	Variety.	Yield per acre.	Weight per bushel.
Wheat	*Polish	21 bushels	60 pounds
			Weight of 12 largest.
Potatoes	1. Early Rose	204 bushels	
	2. Vanguard	200 "	
	3. Beauty of Hebron	180 "	
	4. Empire State	179 "	
	5. Late Puritan	263 "	8 pounds
	6. Early Mayflower	294 "	6 "
	7. White Elephant	245 "	
	8. Snow Drop	238 "	4 "
	9. Pride of the West	198 "	
	10. Triumph	165 "	
	11. Charles Downing	148 "	
	12. Early Ohio	198 "	5 "
	13. Clark's No. 1	243 "	
	14. Early Sunrise	220 "	
	15. White Russet	229 "	
	16. Blue Victor	313 "	8 "
	17. Late Rose	308 "	10 "

*Not a good flouring wheat.

SHERIDAN.

Saskatchewan Fife wheat produced 31 bushels per acre, which was the largest yield. Winter wheat has not been successful on the Sheridan farm as it winter-kills.

The Wide Awake, Probesterre and Race Horse oats each yielded 50 bushels per acre. The first two weighed 42 pounds per bushel, the last 40 pounds. Barley was quite successful. Rye did poorly. Winter rye is sufficiently hardy to make a good crop.

Each variety of potatoes was not reported separately. The average yield was about 150 bushels per acre. They were planted on poor land and did not produce large tubers nor a large crop.

Sheridan.

Crop.	Variety.	Yield per acre.	Weight per bushel.
Wheat	Polish Wheat	20.8 bushels	56 pounds
	French Imperial	25 "	60 "
	Wellman's Fife	25 "	60 "
	Saskatchewan Fife	31 "	60 "
	Blue Stem	25 "	60 "
Oats	Welcome	45.8 "	40 "
	Wide Awake	50 "	42 "
	Probsterre	50 "	40 "
	Clydesdale	30 "	42 "
	Race Horse	50 "	38 "
	White Russian	41.7 "	40 "
Barley	Vermont Champion	27.1 "	50 "
	Manshury	41.7 "	50 "
	Duck Bill	41.7 "	52 "
	New Black	25 "	58 "
Rye	Spring	20.8 "	52 "
	Winter (Fall)	15 "	58 "
	Winter	6 "	58 "
Corn	Squaw	15 "	......
	Self-Husking	18 "	......

SUNDANCE.

No large yields are reported. The largest of wheat was 29 bushels of Whittington. The superintendent states that acclimated seed was used and with wheat it is

far superior to foreign grown. Experiments with oats indicate that early sowing gives better results than where planted late.

This farm is conducted without irrigation and many of the crops were injured by the drouth and hot winds during July. Buckwheat, corn and sorghum were failures. Flax did well considering the season. New Russian yielded 4½ bushels and New Belgian 5½ bushels of seed per acre.

The yield of potatoes is small. Pride of the West, which gave poorer yields at Lander and Saratoga than other varieties, gave the largest yield at Sundance. The experiments with potatoes were conducted to show the relative merits of deep and shallow planting, but no difference was distinguished in the yields or general results.

Sundance.

Crop.	Variety.	Yield per acre.	Weight per bushel.
Wheat	Red Oregon	19 bushels	50 pounds
	Whittington	29 "	50 "
	Saskatchewan Fife	19 "	54 "
	Velvet Chaff Blue Stem	22 "	54 "
	Northcote's Amber	23 "	50 "
	Niagara	16 "	......
Oats	Clydesdale	10½ "	48 "
	Bonanza	9 "	41 "
	Black Tartarian	15 "	43.5 "
	*Golden Giant Side	13 "	40 "
	*New Welcome	9 "	40 "
	*Early Archangel	16 "	50 "
Barley	New Black	10 "	48.5 "
	Vermont Champion	10 "	48.6 "
	Hulless	6 "	33.6 "
Rye	Northern Spring	6¼ " 13 "	50 "
Potatoes	Beauty of Hebron	58 "	......
	White Elephant	71 "	......
	Empire State	47 "	......
	Early Puritan	67½ "	......
	Snow Drop	43 "	......
	Pride of the West	98 "	......
	Early Mayflower	52 "	......
	Early Ohio	65 "	......
	Early Rose	38 "	......

*Damaged by drouth.

WHEATLAND.

Although frost came earlier than usual and some crops were injured by rabbits and kangaroo rats, the yields, given in the following table, are better than might be expected.

White Russian wheat gave the largest yield. Winter wheat was not successful and is not recommended for this part of the state as it is apt to winter-kill or be badly injured by early spring winds. Winter rye is more hardy and successful. Experiments were made with oats to test sowing broadcast and harrowing in the seed, versus planting with press drill. One acre was planted in each way with two varieties of oats. The May windstorms destroyed about half the plants in plats sown broadcast while in the drilled plats, only the tops of the plants were injured. They soon outgrew this injury and as will be seen by the table, yielded from one-fourth to one-third more than that sown broadcast. From all his experience at Wheatland, the superintendent recommends deep planting as more successful than shallow.

The non-saccharine sorghums gave good results, Jerusalem corn yielded one ton of fodder without irrigation. As the season was exceedingly dry it proves the ability of this plant to stand drouth. Red Kaffir corn did not mature and the fodder soured after being frosted.

All the varieties of broom corn tried, did well. The California Golden and Evergreen were especially successful, giving good yields of a first-class quality. The dent varieties of field corn have proved better than flint. Minnesota King yielded 43.6 bushels per acre of excellent grain. The experiment with potatoes to test the value of

planting whole or cut tubers is of especial value. Large tubers were used for the cut seed, with two eyes in a piece. Small potatoes were used for the whole seed. Each was given the same cultivation. The whole seed came up much better than the cut, the plants made a much stronger growth and in each of the nineteen varieties the yield was larger. As will be seen by an examination of the table, the difference in the per cent of marketable potatoes was but little, and though generally in favor of cut seed, it is not always the case. In a few instances the per cent fit for market was greater of the whole seed, and in all, the larger yield gave more marketable tubers. While the difference in the two ways might not be so marked in a favorable year, yet the results of this experiment indicate that planting whole seed is the better.

Crop Report of Wheatland Experiment Farm.

Crop.	Variety.	Yield per acre.	Weight per bushel.	Remarks.
Wheat	Velvet Chaff Blue Stem	23.6 bushels	62 pounds	Wind, May 18, injured plants. Quality first-class.
	White Russian	31.6 "	62 "	" " " "
	Fultz Winter	7.8 "	62 "	Wind, March 26-27 killed 75 per cent of plants. Later wind injured tops.
	Saskatchewan Fife	23.2 "	62 "	Wind, May 18, injured tops of plants badly.
	May Winter	10 "	64 "	Badly injured by spring winds.
Oats	Early Archangel	32 "	46 "	Sown with press drill.
	" "	22.4 "	42 "	Sown broadcast and harrowed in.
	Golden Giant Side	34.4 "	46 "	Sown with press drill.
	" " "	28.5 "	46 "	Sown broadcast and harrowed in.
Barley	Manshury	18 "	53 "	55 per cent of plants destroyed.
	Highland Chief	. . . . . .	. . . . . .	Crop entirely destroyed by rabbits.
	New Black	. . . . . .	. . . . . .	" " " " "
Rye	Spring	17.3 "	58 "	Crop injured by winds.
	Winter	12.3 "	60 "	25 per cent of plants destroyed by wind.
Buckwheat	Japanese	22.6 "	56 "	. . . . . .
	Silver Hull	20.1 "	54 "	. . . . . .
Corn	Minnesota King	43.6 "	58 "	. . . . . .
	Dakota Dent	36.9 "	74 "	Injured by Kangaroo rats.
	Angel of Midnight	14.5 "	74 "	. . . . . .
	Rideout	19 "	72 "	. . . . . .
Broom Corn	Little Dwarf	1640 pounds	. . . . . .	. . . . . .
	Japanese	640 "	. . . . . .	. . . . . .
	California Golden	2176 "	. . . . . .	. . . . . .
	Improved Evergreen	2240 "	. . . . . .	. . . . . .
Fodder Sorghums	Jerusalem Corn	1920 "	. . . . . .	Raised without irrigation.
	Brown Dhoura	5100 "	. . . . . .	. . . . . .
	Red Kaffir Corn	3600 "	. . . . . .	Did not mature.
	Yellow Milo Maize	6800 "	. . . . . .	. . . . . .
	Brotillian	7600 "	. . . . . .	Grain did not ripen, but fodder of good quality.
Field Peas	Scotchman Field	16.4 bushels	64 "	Injured by wind.
	White Field	17.2 "	66 "	" " "
Field Beans	Boston Small Pea Field	18.7 "	63 "	Quality first-class.

Potatoes—Wheatland Experiment Farm.

Variety.	Yield per acre.	Per cent marketable tubers.	Remarks.
Hoffman	107.7 bushels.	85	Cut seed. 10 per cent failed to grow
"	133 "	80	Whole seed. Good stand
Governor Rusk	126.7 "	80	Cut seed. " "
" "	144.4 "	80	Whole seed. " "
Pride of the West	104.2 "	75	Cut seed. " "
" " "	120.5 "	60	Whole seed. " "
Bill Nye	120.3 "	80	Cut seed. 10 per cent failed to grow
" "	136.2 "	70	Whole seed. Good stand
Mammoth Pearl	142.5 "	80	Cut seed. 10 per cent failed to grow
" "	190 "	80	Whole seed. Good stand
Late Puritan	83.5 "	80	Cut seed. 25 per cent failed to grow
" "	133 "	70	Whole seed. Good stand
Empire State	74.7 "	75	Cut seed. 25 per cent failed to grow
" "	149.5 "	75	Whole seed. Good stand
Early Rose	41.2 "	80	Cut seed. 85 per cent failed to grow
" "	120.3 "	75	Whole seed. Good stand
Early Ohio	40.5 "	85	Cut seed. 75 per cent failed to grow
" "	88.7 "	80	Whole seed. Good stand
Early Puritan	72.8 "	75	Cut seed. 40 per cent failed to grow
" "	124.1 "	75	Whole seed. Good stand
Early Mayflower	72.8 "	60	Cut seed. 40 per cent failed to grow
" "	120.3 "	75	Whole seed. All grew
White Elephant	126.7 "	80	Cut seed. " "
" "	137.6 "	85	Whole seed. " "
New Burbank	107.7 "	75	Cut seed. 20 per cent failed to grow
" "	137.3 "	70	Whole seed. 20 " " " "
Snow Drop	110.8 "	65	Cut seed. Good stand
" "	114 "	50	Whole seed. " "
Vanguard	148.8 "	85	Cut seed. " "
"	158.3 "	85	Whole seed. " "
Beauty of Hebron	77.7 "	75	Cut seed. All grew.
" "	104.1 "	60	Whole seed. " "
Jumbo	126.7 "	80	Cut seed. Good stand
"	146.9 "	80	Whole seed. " "
Rose Seedling	104.2 "	80	Cut seed. 25 per cent failed to grow
" "	184.9 "	80	Whole seed. Good stand
Triumph	79.2 "	65	Cut seed. 10 per cent failed to grow
"	101.3 "	60	Whole seed. Good stand

Cost and Profit of Growing Wheat.

B. C. BUFFUM.

Experiments were inaugurated in 1893 on each of the Experiment Farms to determine the cost and profit of raising wheat in Wyoming. As the results will vary with the season, condition of soil, price of labor and market price of wheat, the experiment will be repeated the two coming seasons. It may be observed that in the cost of irrigation, only the expense of applying the water to the land is given, omitting the cost of the water. This item will vary with the locality, size of ditch, distance from source of supply and other conditions. But it is believed that the greatest cost would not reduce the profit shown more than 10 or 12 per cent. The cost of producing a single acre is much more in proportion than that of raising larger areas.

M. R. Johnston, of Wheatland, states, "I believe our figures on cost of crop are at the maximum. Irrigating can be done much more cheaply where there is a larger acreage of crops, and harvesting with improved machinery will reduce that item. Our price on labor of $4.00 per day for man and team is at about the highest limit for common farm labor." One acre was used for each variety in the test, except at Sundance where one-half acre for each variety mentioned in the table, was used. The Sundance Farm being conducted without irrigation, no expense for applying water was incurred. The price in

each instance was the local market price at the time of harvesting. The cost of harvesting at Lander includes cutting and stacking. The reports from Sheridan and Sundance did not include the cost of each item separately. The cost of seed at Wheatland was omitted, but 90 pounds were used, which at one cent per pound would reduce the profit from $5.68 to $4 78. In no case was the yield large. The largest was 31½ bushels at Wheatland.

The results compare closely with those obtained on the Nebraska Experiment Farm in 1892 and published in Bulletin 29 of that Station. The average profit per acre obtained at Lincoln for five varieties of wheat is $8.93, while the average profit obtained in four different parts of Wyoming is $8.86 per acre in 1893.

Cost and Profit with Wheat.

Place.	Variety.	Yield.	Price per pound.	Value of crop.
Lander	Spring Fife	1440 pounds	1½ cent	$21.60
Sheridan	Saskatchewan Fife	1860 "	1 "	18.60
Sundance	Red Oregon	1038 "	1 "	22.38
	Velvet Chaff Blue Stem	1200 "		
Wheatland	White Russian	1898 "	1 "	18.98

Place.	Cost of seed.	Labor putting in crop.	Cost of irrigation.	Cost of harvesting.	Threshing.	Total cost.	Profit.
Lander	$1.86	$5.00	$1.00	$3.50	$2.00	$13.36	$ 8.24
Sheridan	Cost	of putting	in and	raising	crop.	11.71	6.89
Sundance	"	" "	" "	"	"	7.75	14.63
Wheatland	.....	4.50	4.00	2.00	2.00	13.30	5.68

Sugar Beets in 1893.

E. E. SLOSSON.

Experiments in the culture of sugar beets were carried on at the six Experiment Farms during the past season in much the same manner as in preceding years. In addition to this, small packages of sugar beet seed received late in the spring from the U. S. Department of Agriculture were sent to sixty farmers in all parts of the state with franked tags for forwarding sample beets to Washington for analysis. Of the persons to whom seed was given for experiment, only three reported.

All the analyses of sugar beets published this year were made by the U. S. Department of Agriculture in the chemical laboratory at the World's Fair and at Washington.

The details of cultivation are given below :

CROP EXPERIMENTS IN 1893.

LANDER EXPERIMENT FARM.

J. S. MEYER, SUP'T.

Altitude, 5,500 feet. Soil—See analysis in Bulletin No. 6. Weather—See this Bulletin, page 36. Cultivation—Plowed 8 inches deep, harrowed three times; planted in rows 18 inches apart with garden seeder May 11; 15 pounds seed per acre; sprouted May 20; came

up June 4; thinned June 23; cultivated Aug. 12; irrigated Aug. 23; frosted Sept. 22; harvested Oct. 19.

LARAMIE EXPERIMENT FARM.

F. J. NISWANDER, SUP'T.

Altitude, 7,200 feet. Soil—See analysis in Bulletin No. 6. Weather—See this Bulletin, page 36. Cultivation—Plowed 10 inches deep, harrowed twice, rolled; planted 16 pounds to the acre with hand drill May 9; sprouted June 11; came up June 22; cultivated July 6; irrigated June 21-27, July 6-8; yield, 941 pounds per acre. There was no water in the irrigating ditch until June 21 and weather throughout was very unfavorable.

SARATOGA EXPERIMENT FARM.

J. D. PARKER, SUP'T.

Altitude, 6,749 feet. Soil—See analyses in Bulletin No. 6. Weather—See this Bulletin, page 36. Cultivation—Plowed 7 inches deep, harrowed four times, rolled; planted May 9 with hand drill; sprouted May 18, came up June 5; hoed June 20, July 21; irrigated June 17, July 17, Aug. 20; harvested Oct. 15.

SHERIDAN EXPERIMENT FARM.

J. F. LEWIS, SUP'T.

Altitude, 3,750 feet. Soil—See Bulletin No. 6. Weather—See this Bulletin, page 36. Cultivation—Plowed 6 inches deep, harrowed twice, boarded; planted with hand drill May 8, seed 10 pounds per acre; sprouted May

16, came up May 20; hoed June 12-26, July 7, Aug. 6; irrigated June 27, July 18, Aug. 2; harvested Oct. 30.

SUNDANCE EXPERIMENT FARM.

T. A. DUNN, SUP'T.

Altitude, 4,500 feet. Soil—See analysis in Bulletin No. 6. Weather—See this Bulletin, page 36. Cultivation—Plowed 6 inches deep, harrowed four times; planted May 18 four pounds seeds per acre; sprouted May 24, came up June 1; harvested Oct. 10; not irrigated. Rows were 36 inches apart. The yield would probably have been doubled if the rows had been 18 inches apart as is customary.

WHEATLAND EXPERIMENT FARM.

M. R. JOHNSTON, SUP'T.

Altitude, 4,700 feet. Soil—See analyses in Bulletin No. 6. Weather—See this Bulletin, page 36. Cultivation—Plowed twelve inches deep, harrowed six times, rolled; planted May 4 in drills 16 inches apart, 20 pounds seed per acre; sprouted May 16, came up May 22; cultivated four times with plow and hoe; irrigated June 17, 26, July 8, 9, 21, Aug. 8, 28; frosted Sept. 20; harvested Oct. 9.

JOHN ASTLE, AFTON, UINTA COUNTY.

Soil, brown loam. Weather—May cold, June mild, August hot and dry with cold nights, September cold and dry, October 1, snow and rain. Cultivation—Planted May 20; irrigated four times; harvested Oct. 1.

ALFRED BRIDGER, SYBILLE, LARAMIE COUNTY.

Soil, sandy loam. Weather, warm, but very changeable. Planted June 2, harvested Oct. 12.

MARK MANLEY, MOUNTAIN VIEW, UINTA COUNTY.

Soil, sandy loam, second year of cultivation. Weather—May wet, June dry, July hot and dry, August showers, September dry to 15th then heavy rains and snows. Nights very cool all summer. Cultivation—Planted May 10, irrigated four times, harvested Oct. 2.

SUMMARY.

The results of the experiments in the cultivation of sugar beets in Wyoming are as follows:

Season.	Per cent Sugar in juice.	Purity.
1891	15.79	78.08
1892	16.69	78.69
1893	17.07	80.91
Average	16.52	79.23

Analyses of Wyoming Sugar Beets, 1893.

Grown by	Variety.	Crop. Tons per acre.	Average Weight.		Sugar.		Purity.
			Ounces.	Grams.	Per cent in juice.	Per cent in beets.	
Experiment Farm, Lander, Fremont County	Improved Bulteau	28.5	28.5	810	15.8	15.0	83.1
" " " " "	" "	28.5	23.5	657	15.7	14.9	85.4
" " " " "	Klein Wanzleben	24.0	14.3	406	15.9	15.1	78.7
" " " " "	Knauer Imperial	21.0	17.0	481	16.4	15.6	80.9
" " " " "	Vilmorin Richest	20.5	18.6	377	16.2	15.4	77.4
" " Laramie, Albany County	Klein Wanzleben	......	......	......	13.2	12.5	75.9
" " " " "	Knauer Imperial	......	......	......	12.9	12.3	75.9
" " " " "	Vilmorin Richest	......	......	......	13.8	13.1	78.8
" " Saratoga, Carbon County	Klein Wanzleben	16.3	47.0	1330	16.7	15.9	84.8
" " " " "	" "	16.3	......	......	16.8	16.0	81.5
" " " " "	Vilmorin Richest	16.3	47.5	1344	15.8	15.0	85.0
" " " " "	" "	16.3	10.9	310	22.5	21.4	86.1
" " " " "	Improved Bulteau	13.6	......	......	17.7	16.8	83.9
" " " " "	" "	13.6	12.2	347	21.0	20.0	82.7
" " Sheridan, Sheridan County	Klein Wanzleben	17.0	......	......	17.7	16.8	78.9
" " " " "	" "	17.0	......	......	17.2	16.3	86.1
" " " " "	" "	17.0	......	......	17.9	17.0	86.3
" " " " "	Improved Bulteau	10.5	......	......	18.0	17.2	82.0
" " Sundance, Crook County	" "	3.3	16.0	453	17.5	16.6	72.3
" " " " "	Klein Wanzleben	3.1	......	......	14.1	13.4	72.3
" " " " "	" "	3.0	......	......	18.0	17.1	76.0
" " " " "	" "	3.0	13.8	389	16.2	15.4	76.0
" " " " "	" "	3.0	13.5	382	14.5	13.8	73.7
" " " " "	Vilmorin Richest	3.8	......	......	15.7	14.9	72.0
" " " " "	" "	3.8	10.5	297	17.8	16.9	87.8
" " Wheatland, Laramie County	Knauer Imperial	6.8	......	......	17.8	16.9	85.1
" " " " "	Vilmorin Richest	6.2	......	......	18.6	17.7	86.9
" " " " "	" "	6.2	8.5	240	22.7	21.6	86.1
" " " " "	Klein Wanzleben	6.8	10.3	292	22.3	21.2	86.4
" " " " "	Improved Bulteau	6.0	9.3	263	22.9	21.8	89.1
Mark Manley, Mountain View, Uinta County	Klein Wanzleben	......	20.3	575	13.9	13.4	72.4
Alfred Bridger, Sybille, Laramie County	Vilmorin Richest	......	18.7	530	16.6	15.6	79.1
John Astle, Afton, Uinta County	Improved Bulteau	......	21.0	595	13.6	12.9	81.5
Average	......	......	......	......	17.07	16.23	80.91

Experience in these diverse seasons shows that beets unusually rich in sugar can be grown by irrigation in almost all parts of Wyoming. In every crop reported, the per cent of sugar has been above twelve, the lowest marketable rate. From the increase in sugar content and in coefficient of purity we may expect an improvement in the quality of the beets when the land has been longer under cultivation and the growers have acquired more experience. The prices paid at the factories in Nebraska are $5.00 per ton for beets containing 16 per cent sugar and $5.50 for beets containing 17 per cent sugar.

In regard to the yield the results are not as conclusive. In some cases the reported yield is remarkably high, in others altogether too low for profit. In the localities represented by the Experiment Farms at Lander, Saratoga, Sheridan and Wheatland a yield of ten to fifteen tons per acre can be expected under irrigation and proper cultivation.

In ascertaining and publishing the facts concerning the prospects of Wyoming in this new field of agriculture the work of the Experiment Station is completed. It now remains for the people of Wyoming to decide upon the data which have been furnished whether the establishment of sugar factories in the state will be profitable. The Station will, however, furnish any available information on the subject of the culture of beets and the manufacture of sugar to those contemplating the establishment of this industry. Sugar beets will be grown upon the Experiment farms for some years to come to ascertain the effect of the climate, and to test home grown seed, but it is not probable that seed will be distributed free for experimental purposes as heretofore. We shall, however,

be glad to receive the names of any farmers who are willing to experiment in this or other lines. Bulletin No. 3, giving directions for the cultivation of sugar beets, and Bulletin No. 9, giving the results of the crop experiments in 1892, will be sent on application.

The U. S. Department of Agriculture has for several years carried on experiments in sugar beets in all parts of the country, and the following extract from the last report of the Secretary of Agriculture, gives the results of the work in the Arid Region :

"Beets which have been grown upon irrigated land in Wyoming, Idaho, Colorado and New-Mexico are uniformly of high character and rich in sugar. It is evident that there is perhaps no crop which can be so successfuly cultivated upon irrigated land as sugar beets. The cost of irrigated land makes it necessary that some crop should be grown which will yield a large return. Land which has cost from $50 to $100 per acre to irrigate cannot be seeded with financial success to such crops as will yield a net profit of only $4.00 to $5.00 per acre. Such land should be made to yield at least a net profit of from $10.00 to $15.00 per acre in order to pay proper interest on first cost of the soil. There is no crop yet which has been introduced into the arid regions which gives such promise of producing the above result as the sugar beet. The market for sugar cannot be overstocked, hence there is no danger of blocking the market in case all the lands which have been recovered by irrigation should be planted in beets. It would be quite different if they were planted with potatoes or some similar crop, whose overproduction might glut the market. It is no wonder that capitalists

are looking with interest to this new opening for investment.

"Climatic conditions, as has already been stated in previous publications of the Department relating to sugar beets, are of the utmost importance not only in the growing of the crop, but in the harvesting thereof. In the irrigated lands of our arid regions we have a complete control of climatic conditions. In the first place there is during the growing season, almost unbroken sunshine, a a condition essentially favorable to the production and storage of large quantities of sugar. In the second place, the high altitude of the plateaus of the arid regions gives a summer which is not too warm for the proper growth of sugar beets. In the third place, the control of the water for irrigating purposes renders it possible to stimulate the growth of beets during the earlier periods of the summer, while the withdrawal of the water prevents any second growth after the beets have matured in the autumn. In the fourth place, the dry autumnal weather is most favorable to harvesting the crop, and the period of frosts is so well known as to permit of the entire harvest being made before any danger of freezing occurs. It is believed that in no other place in the world can be found such a favorable agreement of climatic conditions for the production of not only large crops of beets per acre, but also of beets rich in sugar of high purity."—*Report of the Secretary of Agriculture, 1892, page 135.*

It will be observed that the expenses here given are too high for Wyoming, as at present good land can yet be obtained at from $10 to $20 per acre, with water right in perpetuity, and the cost of irrigating sugar beets is not more than $1.50 or $2.00 per acre for the season where a number of acres are grown.

Garden Vegetables and Tobacco.

B. C. BUFFUM.

It may be stated in general, that those varieties which were sufficiently early, of good quality and yielded well upon any of the Experiment Farms may be recommended for that part of the state. At Saratoga no yields were given, but some notes were furnished which may be of value. No report of garden vegetables was obtained from Lander. At Sheridan experiments with vegetables were of little or no value. One variety of sweet corn, the Golden Dew Drop, matured seed, yielding 16 bushels per acre. A quantity of water melons were marketed, the varieties which ripened being Cuban Queen, Ironclad, Lewis' Early and Peerless.

Yields at Sundance and Wheatland were good, especially with root crops, including sweet potatoes at the latter place. Experiments with peanuts at Wheatland in 1892 were quite satisfactory, but the crop of 1893 was destroyed by rabbits. At Sundance the peanuts did not germinate.

Tobacco has been successfully grown at Wheatland for two seasons. The notes for the past season are given under a separate head.

GARDEN VEGETABLES.

LARAMIE.

Asparagus.—Two dozen roots set in bed in 1892

came up well. Nineteen lived through the winter and grew nicely the past season.

Beans.—Seventeen varieties were planted. Only wax varieties grown for string beans are recommended for this altitude. Owing to the dry condition of the soil, all varieties were slow in germinating, which made it late in the season before they were ready for market. The earliest varieties were Early Longfellow Six Weeks and Dwarf Horticultural, which were marketed Aug. 8. Early Lima, Early Warwick, Early Mazagan and Golden Refugee were ready for market Aug. 16.

Cabbage.—The varieties planted were Red Erfort, Red Dutch, Prime Flat Dutch, Lee's Wonderful and Early Jersey Wakefield. All matured heads and can be grown with great success.

Cauliflower.—Early Dwarf matures and produces a good crop.

Lettuce.—Those varieties which were ready for market earliest were Early Boston, Curled, Early Curled Simpson and Black Seeded Simpson.

Peas.—Thirty-eight varieties were grown. Though not so early as several others, the Pride of the Market was the most prolific. White Marrowfat was the earliest variety last season and the Stratagem the latest marketed. Telephone and Everbearing proved good varieties.

Beets.—Twelve varieties were grown. The Improved Blood was most prolific, yielding over 6,000 pounds per acre. Eclipse yielded 5,382 pounds, and Extra Early Dark Flat Egypt, 3,848 pounds. Bunches of Early Blood were marketed on Aug. 6.

Radish.—Chartiers Long Scarlet is one of the earliest, most prolific and hardy. Other varieties are French

Breakfast, White Tipped Turnip, Early Round Dark Red. The two last named are more apt to become pithy than Chartiers.

Turnips.—Seven varieties were grown. All were badly damaged by the turnip flea beetle. They were ready for market Aug. 31, and yielded as follows: Early White Egg, an early sweet table variety, 1,025 pounds; Long White Cow Horn, 1,599 pounds; White Stone, 1,189 pounds; Early Purple Top Milan, 1,968 pounds; Robert's Golden Ball, 1,845 pounds; Early White Dutch, 2,685½ pounds; Pomerian White Globe, 5,248 pounds. All are good table varieties.

SARATOGA.

Beans.—Earliest varieties were Extra Early Refugee and Early Warwick. Only wax varieties to be used as string beans can be recommended.

Cabbage—Early York and Winningstadt matured good heads. The late varieties failed to mature on account of drouth.

Cauliflower.—Henderson's Early Snowball gave best results, maturing good heads.

Lettuce.—Boston Market, Black Seeded Simpson and Golden Queen were earliest, being ready for market June 25.

Peas.—Henderson's First of All, Bliss Abundance, Summit, Fill Basket and Champion of England were the earliest varieties and all were very prolific. No yields are given, but the superintendent states that all were successful and especially recommends the above.

Squash.—Winter varieties did not ripen. Crook

Neck and Early Bush summer grew well and produced good table squashes.

Tomatoes.—A few, supposably of the Dwarf Champion, ripened.

SUNDANCE.

Beans.—The earliest were ripe Sept. 1, and yielded as follows: White Wax, 142 pounds per acre; Black Wax, 160 pounds; Navy, 240 pounds; Flageolet Wax, 170 pounds. The last named were ready for table first.

Sweet Corn.—The Mammoth produced roasting ears by August 17, but the crop did not mature and was pronounced a failure.

Peas.—The following varieties with yields are reported: Alpha, 726 pounds per acre; Early Kent, 726 pounds per acre; Champion of England 660 pounds; Stratagem, 640 pounds; Tom Thumb, 655 pounds. All are good varieties.

Beets.—Varieties and yields were: Early Blood, 10,856 pounds per acre; Early Bassano, 11,061 pounds per acre; Early Eclipse, 11,334 pounds; Extra Early Dark Egyptian, 8,840 pounds; Improved Dwarf Dark Blood, 8,893 pounds; Improved Long Blood, 8,316 pounds; Dewing's Early Turnip, 12,512 pounds.

Carrots.—Early Scarlet Horn yielded 7,386 pounds per acre; Early Half Long Stump Rooted, 7,525 pounds; Early Half Long Carenthral 5,123 pounds; Early French Forcing, 4,420 pounds. The half long varieties are considered best.

Parsnips.—Long Neck Sugar yielded 2,727 pounds per acre and Gurnsey Hollow Crown, 2,448 pounds.

Turnips.—White Stone yielded 14,014 pounds; Rob-

erts' Golden Ball, 16,774 pounds. Both are excellent varieties.

Salsify.—Gave a yield of 4,590 pounds per acre.

WHEATLAND.

Beans.—Only one variety was grown, the Boston Small Pea Bean, which yielded 1,120 pounds on an acre and weighed 63 pounds per bushel. The market price was three cents per pound, making the value of the crop $33.60. The estimated cost of producing the crop was $15.25 leaving a profit of $18.35 per acre. This is a fine variety, the vines being strong and thrifty, the beans well formed, of uniform size and excellent quality.

Sweet Corn.—New Honey was ready for market Aug. 20 and yielded 800 pounds of seed. Cory, the earliest and most prolific variety grown, was ready for market Aug. 1, and produced 1,600 pounds of seed. Marblehead was ready for market Aug. 12, but did not mature its seed.

Beets.—Wind storms of May 18 and 19 destroyed from 10 to 20 per cent of the young plants of each variety. The Improved Long Blood gave a yield of 43,776 pounds per acre; a good stock beet. Dark Egyptian produced 13,760 pounds; a good quality for table use or stock. Improved Dwarf Blood, yield 12,800 pounds; good for table use. Early Blood Turnip, yield 14,400 pounds; good for either table or stock. Early Eclipse, yield 14,016 pounds; good quality. Early Blood Turnip and Improved Dwarf Blood were the earliest varieties, but the last did not seem as hardy as the others, as the wind destroyed more of its plants.

Carrots.—Wind destroyed many of the young plants.

As much as half the Early French Forcing were killed. All varieties were of good quality, Half Long Scarlet Courtney and Early Scarlet Horn being the earliest. Early French Forcing produced 9,600 pounds per acre, Early Scarlet Horn, 15,664 pounds; Half Long Stump Rooted, 39,808 pounds, and Half Long Scarlet Courtney 24,640 pounds.

Parsnips.—These were also injured by the wind. Gurnsey or Hollow Crown produced 9,856 pounds of only fair quality; Long Smooth Sugar, 6,272 pounds of good quality.

Sweet Potatoes.—Early Golden, ripe Sept. 20, yield 5,475 pounds; good quality and 75 per cent fit for market. Extra Early Carolina were ripe Sept. 10, yield 6,132 pounds; 80 per cent fit for market; of first-class quality, Red Bermuda, ripe Sept. 20, yield 7,300 pounds; 80 per cent fit for market; the heaviest yielder but of poor quality.

TOBACCO.

A small amount of tobacco was grown in 1892, and did so well that it was given a further trial the past season. Each of the varieties planted grew well and fully matured in good season, being harvested Sept. 9 to 12. A heavy wind storm on Sept. 1 injured all the varieties somewhat. As the weather was so dry after harvesting, the crop could not be stripped so yields cannot be given at this time. The following notes upon each variety indicate that tobacco can be grown with profit, and it is hoped more complete data will be obtained the following season to show the degree of success with which it can be raised extensively:

Pennsylvania Seed Leaf—Twenty-four plants were set out June 2. All lived and were mature Sept. 12. They grew to a good height and produced large leaves.

Connecticut Seed Leaf.—Twenty-four plants set out June 2. All grew to a good height, producing medium sized leaves. It was mature Sept, 12.

Harby.—Twenty-four plants set out June 2, two of which died. The rest grew to a height of four feet, producing large leaves and were mature Sept. 12.

Persian.—Of the twenty-four plants set out June 2, eight died. The plants grew only two feet high and produced small leaves; were mature Sept. 10.

Comestock Spanish.—Twenty-four plants set out June 2. All lived, grew about three feet high and produced medium sized leaves; matured Sept. 10.

Progress Report upon Fruits and Trees.

B. C. BUFFUM.

As this was only the second season from planting, the fruits have not progressed far enough to merit a detailed report of varieties. Only general statements are made about each kind with notes upon hardiness, varieties which have fruited, and necessary winter protection. From the results already obtained, there is little doubt that Wyoming can raise sufficient quantities of the small fruits at least, to supply the home demand. Compared with the profit of raising wheat, of from five to fifteen dollars per acre, it is safe to say that with even lower prices than existing ones, raising fruit near our markets will yield a net profit ten times as great. Our conditions are as favorable as those in adjoining states where fruit raising has advanced rapidly in the last few years. The few farmers who have grown small fruits and the results obtained upon the Experiment Farms sufficiently demonstrate that such fruits will grow successfully, and our future bulletins upon this subject will discuss special topics.

SMALL FRUITS.

Strawberries.—Fifty varieties were planted in 1892, the same ones being ordered for each farm, from growers

in New York, New Jersey and Colorado. From the reports at hand there is no apparent difference in the hardiness and vitality of the plants from our eastern and western growers. Those obtained from Peter Henderson & Co., were pot grown plants. They were large and looked thrifty when they arrived, but having been grown indoors, they were so tender that a large per cent of them died when set out. None survived through the summer at Laramie and few or none lived of many of the varieties upon the other farms. Strawberries require some winter protection. A thorough covering of straw or loose mulch, held down by poles or other weights to keep the wind from blowing it off, is generally sufficient, though where only small areas are grown, earth covering is recommended. At Laramie a covering of earth deep enough to keep the plants from dying out is absolutely necessary to make them live. All the plants upon the Laramie Farm not so covered died the first winter.

At Lander eighteen varieties fruited well, of which the Mammoth is reported as producing the largest berries of fine flavor.

On the Sheridan Farm the superintendent states that Michel's Early, Crescent, Manchester, Lady Rusk, Cumberland, Bubach's No. 5, Gandy and Eureka were the best, being most hardy, prolific and of good flavor.

At Saratoga Edgar Gem, Capt. Jack, Iowa Beauty and Shuster's Gem are mentioned as of best quality and the most productive this season.

Raspberries and Blackberries.—Those varieties which were in good condition when set out made thrifty growth. The cause of failure to live of many plants at Lander,

Saratoga, Sheridan and Sundance was due to the delay in the plants reaching them and their consequent poor condition when set out. Some were on the road over a month and many of the plants were dead or past reviving when received. A few fruited this season. It is necessary to cover with earth for winter protection and deep enough to keep the canes moist. All the raspberries set out upon the Laramie Farm died the first winter. A small per cent of the blackberries lived.

Grapes.—Have not done well at Laramie and Sundance, though the causes of failure are not apparent. In general the same causes produced failure, and the same winter protection is necessary as with raspberries. Except upon the above mentioned farms they are growing well.

Currants and Gooseberries.—Are sufficiently hardy for any part of the state. On the Laramie Farm the most hardy varieties tried are Black Naples, Crandall, Fay's Prolific and White Grape currants and Smith's gooseberry. At Saratoga White Grape currant bore heavily, the bushes bending nearly to the ground with fruit. The only winter protection necessary is a mulch around the roots.

LARGE FRUITS.

Apples, plums and cherries are thriving at all the farms. The crab trees have made the largest growth at all the farms and the hardy varieties of standard apples set out have lived and grown especially well at the Lander, Sundance and Wheatland Farms. At Lander English Morello and Early Richmond cherries each bore and ripened a small quantity of fruit.

At Saratoga Dakota plum trees made a good growth and bore a few plums though they did not ripen on account of the early frost.

The pears set out which lived through the first season as a rule have thrived. Apricots have not been quite so successful, though some trees of all varieties lived at Wheatland, and all but the Russian at Lander. The Gibb apricot at the latter place made the largest growth of any tree planted. This variety has done well at the other farms and seems to be very hardy. Except at Wheatland, quinces have not appeared to be sufficiently hardy.

Native plums, buffalo berries, june berries, raspberries and strawberries have been transplanted to the Experiment Farms. We have not succeded in making the buffalo berries, strawberries or raspberries grow on the Laramie Farm. Lack of water and their exposed position is probably the reason, as all our natives are acclimated and hardy.

FOREST TREES.

Cottonwoods and Russian Willows have been set out on each of the farms for windbreaks. The Russian willow cuttings have made thrifty growth and seem perfectly hardy. At Laramie all those which started the first season made good growth and are alive to the tips at the present writing. Complaint has been made that they produce too many small whip like stems instead of growing at once into trees. After two or three years' growth they usually stop spreading from the root and grow more upright.

The growth of Honey Locusts set out at Laramie in

1891 for hedge has been exceedingly slow. A large per cent of the trees are still alive but only a few short branches have been put forth.

Ash and Elm seedlings have thrived well, though at our high altitude their growth is slow. The White Ash seedlings seem hardy and at Lander are highly spoken of as making stocky little trees.

Notes on Climate.

B. C. BUFFUM.

During the year of 1893 the climate has been exceptional in many respects and unfavorable to the growth of crops.

For the greater part of the state the temperature was lower than in 1892. At Laramie the means varied but little from that of the two preceding years, but the months of March, April, May, September and November were colder than the same months in 1892, while the months of June, July and August were warmer and drier. This shortened the growing season and caused the warm months to be more unfavorable than in the preceding year. In general the same difference in temperature between this and previous years prevailed at all the Experiment Farms, September being notably colder at each. Killing frosts occurred earlier in nearly all parts of the state than in 1892. There were no heavy storms of snow or rain during the year, consequently the amount of precipitation was unusually small. A letter from E. M. Ravenscraft, Director of the State Weather Service, states: "The rainfall for 1893 was below the normal throughout the entire eastern portion of the state and the absence of heavy storms was remarkable." He kindly furnished the data for Cheyenne, which is given in the table of precipi-

tation. The normal for Cheyenne is about 12.50 inches. The greatest precipitation during one day occured at Sundance in May, when 2.18 inches of rain fell. At Laramie the greatest amount during any single storm was 0.47 inches in June and August. At Lander 1.01 inches in June. At Saratoga 1.20 inches in May. At Sheridan 1.70 inches in May. At Wheatland 0.60 inches in October and December. Saratoga was the only Station having a greater amount of precipitation than in 1892. There was an unusual amount of rain in August and several quite heavy snow storms occurred in the Platte Valley during the year. The precipitation at Laramie was less than ever before recorded at this place, being only 3.84 inches. The Report of Rainfall in the Western Territories, issued by the Department in 1888, states that records of precipitation were kept by the U. S. Post Hospital at Fort Sanders, three miles south of Laramie, covering a period of nine years and five months from Feb. 1869 to Aug. 1878. During this time the normal was 12.92 inches. The greatest amount during any one year was 17.77 inches in 1872. The least occurred in 1871, when only 8.16 inches fell. The least annual precipita- which has been observed in the state is 2.38 inches at Fort Laramie in 1860.

The small amount of rainfall at Laramie in 1893 seems to be due to the fact that the storms precipitated the larger part of their moisture on the mountain ranges east and west of the Laramie plains, causing only traces or small amounts at Laramie. At the Experiment Farm, nearly three miles west of the University, the rainfall for the growing months was much heavier than at the University. The rainfall at the farm for May was 2.00 inches,

June 1.16, July 0.94, August 1.10. Several quite heavy rains occurred which only gave a trace in town. At Wheatland the rainfall was less than half, and at other stations, except Saratoga, much less than that of the previous year.

Hail storms occurred on the 28th and 29th of June, near Sheridan, destroying tender vegetation in a path about one mile wide.

The number of stormy days during which .01 or more rain fell are as follows: Laramie 44, Lander 38, Saratoga 50, Sheridan 46, Sundance 51, and Wheatland 20. The greatest number in one month was 11 at Saratoga in May. None occured in Laramie in January.

The mean relative humidity or per cent of moisture in the air was much lower than the previous year, being 63.7 in 1892 and 56.9 in 1893. June was the driest month with only 38.3 and July and September were nearly as dry. The mean dew point for the year was correspondingly low.

There was over 10,000 miles more of wind than in 1892.

EVAPORATION AT LARAMIE.

Evaporation from water surface is measured by means of a Hook Gauge, measurements being taken every day that the water is not frozen. A tank of galvanized iron holding one cubic meter of water is used. Care is taken to keep the tank nearly full that evaporation may not be interfered with. Evaporation cannot be obtained as accurately for the winter months as during the remainder of the year. It was, apparently, 46.305 inches from Oct. 1, 1892 to Oct. 1, 1893. For six months, May to

October inclusive, it was 37.525 inches. During the time the water was not frozen, it was as follows:

April 24-30	0.562 inches.
May	4.801 "
June	7.884 "
July	9.352 "
August	6.586 "
September	6.016 "
October 1-31	2.886 "

EXPLANATION OF TABLES.

TEMPERATURE.—The mean temperature at the Experiment Farms is taken from the maximum and minimum readings. At Bates' Park (Freeland) the observations are taken by Mrs. C. M. Cheney three times daily, at 7 a. m., 2 p. m. and 9 p. m. and the mean for each day is found by the formula $\frac{7+2+9+9}{4}$.

At Inyan Kara the observations are taken by S. A. Young twice daily and the mean is obtained by the sum of both readings divided by 2, which probably gives results too high for summer months, but nearly as close to the actual mean in the cold months as that from the maximum and minimum readings, since during these months the minimum temperature usually occurs near 7 o'clock a. m. and the maximum between 2 and 3 o'clock p. m. The daily range of temperature is the difference between the maximum and minimum readings.

In Table IV. the records of the barometer are not complete, as the instrument was out of order for nearly four months and consequently the annual mean is not correct.

In the same table, also, the amount of wind is given

only for each month, with the greatest velocity for the month. For further data on the wind see General Summary.

The precipitation at each Experiment Farm, given in Table V., is observed by the superintendent. The record for Cheyenne was furnished by the Chief of the State Weather Service, for Bates' Park (Freeland) by Mrs. C. M. Cheney, for Trelona by James Jackson, for Inyan Kara by S. A. Young, for Hat Creek by Andrew Falconer and for Sybille by A. E. Bridger. Thanks are due each of these observers for the interest taken and time spent in furnishing the records. We hope others will volunteer to furnish records of rainfall. Observations at high altitudes in the mountains would be of special value.

TABLE NO. I. *Temperature, 1893.*

Place.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
Laramie	26.8	20.7	28.8	34.2	44.2	57.2	64.0	60.7	52.8	42.3	29.2	26.6	40.6
Lander	29.3	21.5	29.2	36.4	50.0	62.2	69.6	66.2	57.5	44.9	34.3	30.3	44.3
Saratoga	22.1	17.6	28.8	34.5	45.0	56.3	64.1	60.9	49.9‡	41.0	26.9	24.8	39.3
Sheridan	23.6	12.9	12.5*	38.6	51.9	61.3	69.2	65.4	57.8	44.3	27.2	23.6	40.7
Sundance	19.7	14.6	21.5†	35.2	48.6	62.1	69.0	66.1	57.6	41.7	27.6	23.8	40.6
Wheatland	33.1	29.0	36.7	41.0	53.0	67.3	74.1	69.6	62.4	49.3	37.6	32.5	48.8
Freeland (Bates' Park)	20.2	24.0	31.4	37.4	47.3	64.5	73.1	67.8	60.8	45.4	31.9	29.7	44.5
Inyan Kara	21.1	20.2	25.8	35.9	51.7	71.2	76.0	69.0	....	....	....	....	....

*First 21 days of month. †8 a. m. and 8 p. m. ‡First 10 days of month missing.

TABLE II. *Daily Range of Temperature.*

Place.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
Laramie	22.0	21.1	20.6	21.7	25.9	32.8	30.8	28.0	33.1	24.4	22.5	16.8	25.0
Lander	24.1	24.0	23.6	21.5	24.6	28.8	27.4	27.1	26.6	25.2	22.8	20.7	24.7
Saratoga	19.6	22.9	21.9	24.2	25.4	32.3	34.9	32.4	37.3†	26.4	26.1	22.0	27.1
Sheridan	22.8	28.2	24.5*	22.6	25.3	29.4	37.4	37.8	36.2	29.1	25.0	23.7	28.5
Sundance	19.3	23.1	......	20.0	24.1	27.0	29.0	28.7	32.5	24.5	24.3	21.4	24.9
Wheatland	26.3	26.3	27.7	28.5	31.7	34.8	34.6	34.9	37.1	33.1	26.8	28.5	30.9

*First 21 days. †First 10 days missing.

TABLE III.—*Weekly Means of Soil Temperatures, Laramie, 1893.*

Week ending—	Air Temperature.	3 inches.	6 inches.	12 inches.	24 inches.	36 inches.	72 inches.
January 7	32.8	28.5	29.1	29.6	31.3	33.3	39.2
January 14	25.1	24.6	27.0	29.0	31.4	33.1	38.5
January 21	16.3	17.3	21.1	24.4	28.6	32.0	37.8
January 28	32.4	28.0	28.5	28.4	29.1	31.0	37.2
February 4	22.9	23.4	25.5	27.7	29.4	31.3	36.6
February 11	21.9	23.0	25.7	27.3	28.8	30.9	36.3
February 18	19.7	21.4	24.5	26.1	27.9	30.2	35.8
February 25	24.4	24.2	26.6	27.8	28.8	30.3	35.5
March 4	17.3	21.8	24.3	25.8	27.4	29.6	35.1
March 11	29.2	28.4	20.6	29.4	29.4	30.2	34.9
March 18	23.5	27.4	29.5	29.7	30.2	30.9	34.7
March 25	27.9	29.5	31.4	31.1	30.8	31.2	34.7
April 1	30.1	35.9	35.3	32.1	31.4	31.6	34.9
April 8	41.0	39.9	40.5	37.2	32.7	31.9	35.0
April 15	27.7	31.9	34.2	34.1	33.6	33.4	35.1
April 22	31.6	34.6	36.5	35.5	34.6	34.4	35.6
April 29	37.5	38.7	41.1	41.2	38.4	37.1	36.4
May 6	33.8	37.8	40.5	40.4	39.6	38.9	37.6
May 13	45.1	46.9	47.7	45.6	42.1	40.6	38.8
May 20	53.7	55.2	56.2	54.2	49.2	46.5	40.8
May 27	40.4	46.9	48.4	49.2	48.4	47.5	43.0
June 3	46.5	52.5	53.1	51.8	48.9	47.7	44.1
June 10	52.5	54.2	55.0	53.4	50.2	48.9	45.1
June 17	61.5	65.1	65.3	62.6	56.8	54.1	46.8
June 24	60.5	68.0	68.6	66.2	60.7	57.9	49.3
July 1	59.3	66.6	67.6	65.9	61.8	59.5	51.4
July 8	65.2	70.7	71.0	69.0	63.7	61.1	53.1
July 15	63.7	68.8	70.5	68.8	65.0	62.6	54.6
July 22	64.8	72.1	73.5	70.3	65.5	63.0	55.8
July 29	63.8	67.9	70.6	69.6	66.4	64.2	56.8
August 5	62.2	67.0	69.7	67.9	65.0	63.2	57.3
August 12	62.8	66.1	69.2	67.7	64.9	63.3	57.6
August 19	61.3	63.0	66.5	65.8	63.6	62.4	57.7
August 26	60.4	64.9	67.4	66.3	63.6	62.1	57.5
September 2	54.9	60.0	62.7	62.9	61.9	61.2	57.4
September 9	58.6	60.2	65.3	63.2	61.3	60.3	57.1
September 16	55.0	60.9	63.4	62.4	60.7	59.9	56.8
September 23	51.2	55.7	59.5	59.4	59.1	58.8	56.4
September 30	45.9	51.2	55.5	56.1	56.5	56.6	55.8
October 7	38.8	39.4	43.3	46.3	51.1	52.8	54.6
October 14	44.0	42.9	46.0	47.5	49.2	50.3	52.9
October 21	45.7	43.3	46.0	46.3	47.6	48.6	51.6
October 28	39.7	40.5	42.3	43.9	46.5	47.7	50.4
November 4	38.7	40.3	42.1	42.9	44.9	46.0	49.4
November 11	35.2	36.8	38.8	40.3	43.0	44.4	48.3
November 18	25.8	31.0	33.3	35.4	39.9	41.9	47.0
November 25	20.9	26.3	28.3	31.0	36.4	39.0	45.4
December 2	32.8	31.5	42.2	32.9	35.6	37.5	44.0
December 9	23.8	28.4	30.5	32.6	36.2	37.8	43.0
December 16	31.2	28.9	29.9	31.7	35.1	36.9	42.3
December 23	32.3	29.1	29.6	30.3	33.7	35.6	41.5
December 30	18.6	23.5	26.0	29.1	33.1	34.7	40.6
Sums	2120.9	2242.1	2355.9	2345.3	2331.0	2335.9	2355.1
Annual Means	40.8	43.1	45.3	45.1	44.8	45.0	45.3

TABLE IV. *Laramie, 1893.*

Month.	Relative Humidity.			Dew Point.			Barometer.			Wind.			Terrestrial Radiation.	
	Highest	Lowest	Mean.	Highest	Lowest	Mean.	Highest.	Lowest.	Mean.	Greatest Velocity	Miles.	Direction.	Highest	Mean.
January	91.8	9.2	56.0	29.3	−16.0	5.8	23.307	22.501	22.970	50	11397.7	W	7.7	3.7
February	100	23.0	70.8	21.4	−8.5	7.4	23.249*	22.561*	22.887*	48	9073.3	W	5.8	3.3
March	100	29.8	67.7	30.0	−0.5	14.9	....	....	....	48	12520.0	W	8.0	2.7
April	100	23.4	62.3	34.5	4.7	18.9	....	....	....	60	11347.2	SW	6.7	2.3
May	95.0	15.7	54.7	38.9	12.0	26.0	....	....	....	68	10970.4	W	5.5	3.0
June	95.2	10.9	38.3	50.1	13.5	30.2	23.225†	23.059†	23.144†	48	9139.0	SW	10.2	4.2
July	81.3	9.5	43.9	54.5	13.3	38.8	23.363	22.946	23.264	50	10406.0	SW	6.3	4.1
August	90.9	16.4	50.8	49.7	26.7	40.7	23.396	23.040	23.189	60	9456.0	S	6.3	3.1
September	92.8	11.2	43.2	52.6	10.0	27.1	23.418	22.698	23.093	48	10316.3	S	11.0	4.6
October	100	20.8	57.2	30.4	10.5	22.2	23.348	22.766	23.183	48	10910.9	SW	7.2	3.0
November	100	20.0	66.6	28.8	−10.5	13.5	23.298	22.712	23.014	56	9448 0	SW	7.5	3.8
December	100	38.3	70.9	30.1	4.3	14.9	23.297	22.756	22.666	48	11352.0	W	6.8	3.6
Means	....	....	56.0	....	....	21.7	....	....	23.196	....	10603.1	....	....	3.5

*First 12 days. †Last 10 days.

TABLE V. *Precipitation, 1893.*

Place.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Laramie	Trace.	0.11	0.29	0.32	0.33	0.54	0.34	1.08	0.39	0.28	0.06	0.10	3.84
Lander	Trace.	1.24	0.84	3.20	2.17	1.06	0.25	1.12	0.43	0.43	0.48	0.40	11.62
Saratoga	0.40	0.90	0.85	2.00	2.70	0.80	0.55	2.24	0.80	1.48	0.70	1.10	14.52
Sheridan	0.35	1.20	0.33	1.20	3.40	0.88	0.31	0.12	1.57	1.04	1.40	0.80	12.60
Sundance	0.80	1.60	0.90	1.45	3.49	1.75	1.75	0.97	0.46	1.84	0.50	1.05	16.56
Wheatland	0.20	0.40	1.00	1.40	0.90	0.10	0.55	0.27	Trace.	0.60	0.30	0.70	6.42
Cheyenne	0.08	0.87	0.78	1.36	1.64	1.33	0.09	1.14	0.29	0.22	0.29	0.53	9.22
Bates' Park (Freeland)	0.90	1.20	2.70	3.30	2.80	2.20	1.20	0.45	0.15	1.25	0.80	2.30	19.25
Trelona	0.08	0.29	0.28	0.73	0.86	1.17	1.31	0.51	....	....	....	....	....
Inyan Kara	0.50	0.90	0.70	Trace.	2.85	2.45	1.53	1.28	....	....	....	....	....
Hat Creek	0.16	0.36	0.58	1.35	0.87	0.62	1.39	0.43	0.30	0.97	0.25	0.99	8.27
Sybille	....	....	....	1.69	1.68	0.72	1.46	0.76	0.26	1.21	0.74	....	....

GENERAL SUMMARY.

Highest Temperature.—Laramie, 87.2, July 21; Lander, 94, July 19; Saratoga, 89, July 21; Sheridan, 102, July 20; Sundance, 96, July 22 and Aug. 6; Wheatland, 108, June 18.

Lowest Temperature. — Laramie, —9.2, Feb. 27; Lander, —10, Feb. 14; Saratoga, —13, Jan. 16; Sheridan, —45, Feb. 1; Sundance, —31.5, Jan 31; Wheatland; —16, Jan. 28.

Highest Daily Range of Temperature.—Laramie, 45, Sept. 14; Lander, 45, Jan. 26; Saratoga, 53, Jan. 30; Sheridan, 55, Oct 21; Sundance, 49, Feb. 4; Wheatland, 55, March 30.

Lowest Daily Range of Temperature.—Laramie, 0.5, Dec. 2; Lander, 3, March 22; Saratoga, 5, April 25; Sheridan, 0, April 29 and Nov. 17; Sundance, 2, Feb. 5, April 24 and May 24; Wheatland, 0, April 17.

Highest annual mean temperature, 48.8, Wheatland.

Lowest annual mean temperature, 39.3, Saratoga.

Average annual mean temperature for six experiment farms and Bates' Park (Freeland), 42.7.

Killing Frosts.—Laramie, June 6 and Aug. 16; Lander, May 24, 25, 26, 27, and Sept. 22 and 23; Saratoga, light frosts June 14 and 24, killing Aug. 15 and 27; Sheridan, May 27 and Sept. 23; Sundance, May 22 and Sept. 23; Wheatland, light frost May 19 and killing Sept. 23, 24 and 25.

Greatest annual precipitation, 19.25 inches, at Bates' Park (Freeland).

Lowest annual precipitation, 3.48 inches, at Laramie.

Average precipitation in 1893 for the places furnishing complete records, as given in the table, 11.36 inches.

OTHER OBSERVATIONS AT LARAMIE.

Highest terrestrial radiation, 11.0, Sept. 8.

Lowest terrestrial radiation, 0.0, Feb. 1, April 25, May 6.

Lowest relative humidity, 9.2, Jan. 8.

Mean relative humidity for the year, 56.9.

Highest dew point, 54.5, July 26.

Lowest dew point, —16.0, Jan. 16.

Mean dew point for year, 21.7.

Greatest monthly evaporation, 9.35 inches, July.

Total evaporation for six months, May to October, inclusive, 37.525 inches.

Highest barometer, 23.418, Sept. 1.

Lowest barometer, 22.501, Jan. 31.

Mean barometer for year, 23.196. [Record not complete.]

Prevailing direction of wind, southwest and west.

Greatest velocity of wind, 68 miles per hour, May 25.

Total number of miles traveled by wind in year, 127,236.8.

Greatest number of miles traveled in one month, 12,500, March.

Lowest number of miles traveled in one month, 9,139, June.

Average number of miles traveled in one month, 10,603.1.

Greatest number of miles in one day, 713, March 12.

Lowest number of miles in one day, 54, Nov. 30.

Mean daily distance, 348.6 miles.

Mean hourly distance, 14.5 miles.

UNIVERSITY OF WYOMING.

Agricultural College Department.

WYOMING EXPERIMENT STATION,

LARAMIE, WYOMING.

BULLETIN NO. 18.

JUNE, 1894.

I. The Reclamation of Arid Lands.
II. The Harvey Water Motor.

BY THE DIRECTOR.

Bulletins will be sent free upon request. Address: Director, Experiment Station, Laramie, Wyo.

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The Artesian Wells of Southern Wyoming:

Their History and Relation to Irrigation.

J. D. CONLEY.

The problem of water supply, from whatever source, whether for commercial or domestic purposes, is of vital importance to the arid regions. The bills which have been passed by congress for the investigation of subterranean waters, and the appropriations made by it for the sinking of artesian wells, illustrate its great public interest. On June 16th, 1894, an appropriation was made for artesian wells at Pine Ridge, Red Bud and Standing Rock agencies.

We quote here from Washington correspondence, headed "To Locate Artesian Wells": "Washington, May 23, 1894.—Representative Doolittle (Wash.) has introduced a bill to appropriate $100,000 for ascertaining the subterranean water supplies in the states of Idaho, Montana, Washington and Oregon lying east of the Cascade mountains, and ascertaining the localities at which artesian wells can profitably be dug."

Wyoming, so far as I know, has been exempt from such government aid—whether from her system of rivers and their tributaries giving her the best surface water distribution of any of the Rocky Mountain states; or from an oversight of those in authority to press her claims in this direction, we are unable to say; however, it is a fact

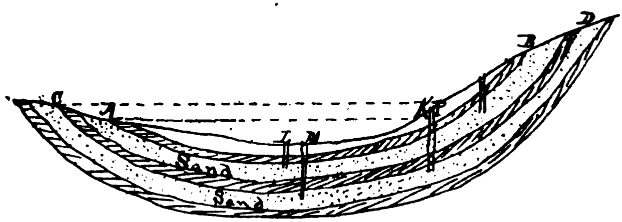
that in comparison with other states and territories, we have hardly made a beginning in this method of procuring water either for irrigation or domestic purposes.

By investigating the Biennial Report of the State Engineer of Wyoming for 1891 and 1892, one can see with what propriety he has divided the state into four natural water basins. We would naturally infer that there were the same number of artesian basins. There are at least as many, and probably many more.

THE CONDITIONS NECESSARY FOR AN ARTESIAN SUPPLY.

The source of water should be higher than the well, a pervious or porous stratum should be situated between impervious strata; and it is quite essential that the strata should be continuous, for if there is a fault in the stratum the water will come to the surface or be lost in subterranean currents. Such I believe to be the case at the Laramie City springs.

The following cut was obtained from the Colorado Experiment Station; it was used in Bulletin No. 16 on Artesian Wells. We also quote the description of the same from their Bulletin:



"The region where artesian wells are found is generally spoken of as an artesian basin, largely because the typical form of such a region is a genuine basin, with the rim higher than the center. A section of the Denver

basin is of this form. The figure may represent an exaggerated section of such a basin, with the porous strata outcropping at B, D, C and A. Anywhere lower than the line AK flowing wells might be expected if the strata are continuous, but as we reach K or some point nearer B, it will be found that water comes only to the surface, and still higher it may fail to reach the surface. It is also evident that while at P flowing water will not be obtained from the upper stratum, by going deeper it may be secured, because the outcrop of the stratum which furnishes it is higher.

"The figure also shows why the pressure is generally greater as the depth is greater. This fact has given rise to a popular belief that if one only goes deep enough flowing water will surely be obtained. Unless the proper conditions are present this is not true, and it is useless to expend money in that hope."

There is some difference of opinion as to what constitutes an artesian well. It is generally applied to wells of great depth, whether it be a flowing well, or some force be required to bring the water to the surface; but it should be only applied to flowing wells, or to those that rise very nearly to the top of the ground. The name is derived from Artois, a province of France—not that they were used there first, for thousands were sunk in China centuries before; and it is quite remarkable to observe the similarity of the drills in use then and now. It has been proposed by some to distinguish between the two classes of artesian wells, calling those that flow positive, and those that rise to a considerable height but do not flow negative artesian wells. They are not dependent upon any particular geological formation. In northern Illinois

one might claim with a show of propriety that they are dependent upon the Silurian Age, for in the northern part of the state the Silurian is the prevailing surface rock, and in sinking artesian wells they have to drill through the Upper Silurian and the Trenton of the Lower Silurian, and water is found in the next lower epoch, the St. Peter's Sandstone, or in the Calciferous epoch. Herewith is a typical well, as given by Prof. Worthen in volume two of the Economical Geology of Cook county, Illinois: "Although only the limestone of the Niagara Group appears in the surface out-crops in the county, we yet have a complete section of the underlying rocks, afforded by the artesian wells which have been bored in the city of Chicago and its immediate vicinity. Of the deepest and in other respects the most satisfactory for geological information, is the boring at the Union stockyards, southwest of the city, which passes through the strata from the upper portion of the Niagara Group to the Lower Magnesian Limestone. The whole depth penetrated was eleven hundred and five feet, and after about forty-six feet of drift and surface deposits, the strata were passed through in the following order:

NIAGARA GROUP, 254 FEET.

1. Bluish gray limestone.
2. Light gray limestone, slightly varying in color at different depths.
3. Limestone, nearly white . . . . [illegible]0 feet
4. Limestone, buff or drab . . . . 80 "

CINCINNATI GROUP, 250 FEET.

5. Shale, soft and fine . . . . 104 "
6. Limestone, light gray . . . . 20 "
7. Coarser and arenaceous . . . . 126 "

TRENTON GROUP, 330 FEET.

8. Brownish ferruginous limestone . . . . 25 "
9. Grayish limestone, more or less dark . . . . 305 "

ST. PETER'S.

10. Whitish brown sandstone ....155 "

LOWER MAGNESIAN LIMESTONE, 70 FEET.

11. Light colored limestone, very hard...... 60 feet
12. Gray limestone...................... 10 "

This last subdivision corresponds to the Calciferous Sandstone of the New York report. In Peoria, Tazewell, Grundy and adjoining counties the water-bearing rock is found in the Niagara, instead of the Lower Silurian; and still further south, where the Carboniferous formation is thicker, the necessary conditions may prevail to get artesian wells from the Carboniferous Group. This was a debatable question a few years ago in the Natural History Association of Illinois, of which the writer was a member. The question as to the northern part of the state was decided satisfactorily. While the province of Artois, in France, where the wells are abundant, and whence the name was derived, consists of Cretaceous strata, wells from other geological horizons might be cited. They depend no more upon any particular formation than do petroleum and natural gas. However, by studying the geological formation of any particular region, we may determine with some precision as to the depth at which water may be struck.

Artesian basins are commonly found in synclinal basins of sedimentary rock, and by getting the dip of the rock and finding where the exposed edges of the rock come to the surface on the rim of the basin—knowing these two facts the problem as to the depth is a simple one in trigonometry. From the great cost of sinking artesian wells in Wyoming, it is very evident that it is too expensive a method of water supply to sink wells for irrigation purposes. As a matter of interest, we call atten-

tion to two remarkable artesian basins to show what has been done by this method of irrigation.

SAN BERNARDINO BASIN, CALIFORNIA.

In the San Bernardino basin, California, 1,000 wells exist, whose depths average 200 feet. Some irrigate 100 to 200 acres, but this is exceptional. "It is quite evident that such an enormous quantity of water, from such shallow wells, makes the sinking of artesian wells for irrigation purposes practicable and very desirable."

SAN LUIS BASIN.

The following is from the Colorado Bulletin No. 16:

"The San Luis basin is the most remarkable of any yet developed in the state. Though here water was found by accident by S. P. Hoine as recently as the fall of 1887, while sinking a sand point for an ordinary drive well, the ease and cheapness of sinking have been such that there are now probably as many as 2,000. They are so numerous that the residents give no more than a passing glance to one, and as they are frequently sunk in less than half a day with the simplest of outfits, it is not remarkable that it is impossible to secure any kind of a complete list even of a limited locality. Wells are often sunk for $25, and they range from this price upward, according to circumstances. In consequence it is cheaper to bore artesian wells than it is to attempt to dig wells of the ordinary kind, without the added inducement of the purer water. Hence within the limits of the flowing area nearly every occupied quarter section has a well, and sometimes more. The town of Monte Vista has 88; La Jara at least 17; S. E. Newcomb 8, and wells in corresponding numbers are found all over the valley." Other incidents might be

cited in the arid regions where the expense of boring, and the large flow of water, together with the favorable climatic conditions, change barren deserts into fertile regions. The most remarkable artesian well that I have seen is in Nevada, Vernon county, Missouri. It is not needed for irrigation purposes. The authorities have made two artificial lakes and laid out a park of 130 acres. It is known as the White Sulphur Springs and Lake Park, Nevada, Missouri. By excellent taste it has been made a charming and lovely resort, a beautiful and picturesque landscape. The well is 780 feet deep, and the water is forced by natural pressure up through an eight inch pipe, and overflows, forming a top like an umbrella, or like a weepitg willow. It fills the two lakes, one of eight acres, the other three acres, varying in depth from four to seven feet. The water, besides being as plersant to the taste as the various Sulphur Springs of New York, is very pleasant and invigorating for bathing purposes. There is probably enough water in that well to irrigate four or five sections of land in the arid regiôns. So then in answer to the question: "Whether it pays to to sink artesian wells for irrigation purposes?" we would say that it depends, first, upon the cost of sinking the well, and second, upon the flow of water.

ARTESIAN WELLS OF SOUTHERN WYOMING.

The most remarkable wells of Wyoming are the two which have been sunk in Rawlins, Carbon county, during the past two years. They are half a mile east of the depot, on the south side of the railroad track. The first well was commenced in May, 1892, and was finished in October. Water was first struck at a depth of 305 feet, the second flow at a depth of 432 feet. The material through

which they passed for the first 220 feet consisted of a yellowish sand, containing alkali. The next 85 feet, a natural cement and gravel. Then 21 feet of blue limestone, beneath which was 100 feet of red ochre. Then came 6 feet of shale overlying a dark colored sand, in which was struck the main flow of water. Charles E. Blydenburgh informed me that a thin layer of magnesian limestone capped the water bearing rock ; he also thought that the red ochre was of the Triassic formation. The boring was continued in this stratum for thirty-five feet, making the total depth of the well 467 feet. There were 305 feet of 10 inch casing, within which were 430 feet of $5\frac{5}{8}$ inch casing. The first flow was a small vein, and was cased off. The total cost was $9 per foot for 467 feet, making $4,203. The flow is 108,000 gallons per twenty-four hours ; and this flow has been constant from the beginning. Well No. 2 was sunk 60 feet northeast from No. 1. The big flow was struck November 2, 1893. The kind of rock for 220 feet was a yellowish sand rock, containing alkali. The next 80 feet was cement and gravel. Instead of the blue limestone at this depth in the other well there are five feet of shale, in which a small vein of water was struck. Then came about 100 feet of the red ochre ; then five or six feet of yellowish sandrock and about 22 feet more of the red ochre. At the depth of 426 feet they met with six feet of blue clay, then came the dark sand, at a depth of 36 feet in it water was struck, after which the boring was continued 18 feet, making a total depth of 486 feet. The cost of drilling, not counting the casing, was six dollars per foot. Although this well is but 60 feet away from the other, there is four times the flow of water, 432,000 gallons per twenty-four hours. Strange to say it has not affected the flow from the other well up to the

present writing, August, 1894. Both wells were drilled by W. W. Breese of Laramie. E. J. Fulton furnished most of the facts for the Rawlins wells. There is a 500 foot well at the court house in Rawlins. The water rose nearly to the top, and in pumping it sand would get into the pipe, hence the well was abandoned. Mr. McCutcheon informs me that R. M. Galbraith was the contractor, and at 475 feet it was a flowing well, but in going down the 500 feet he struck a crevice, and it ceased to be a flowing well. H. Rasmusson informed me that the total cost of well No. 2. was $4.500, which added to the cost of well No. 1, $4203, makes the total cost of the two wells $8,703. The total flow of the water is 540,000 gallons every twenty-four hours. The temperature of the water on August 1st was 51 degrees, while that of the atmosphere was 77 degrees. The water of both wells flow together and is forced by steam power throughout the city. The question arose at once with me as to its source. In investigating the hills that enclose Rawlins on the north, west and south and observing the varied dip of the rock, I saw that the basin was too small to furnish such an immense supply of water. Fort Steele is 240 feet lower, and 15 miles east of Rawlins. The North Platte, one of the largest and most important water courses in the state, is thirty-five yards wide there, and has such a vast volume of water it would be reasonable to suppose that it percolated through the porous rock and produced the Rawlins artesian basin; but one of the conditions of an artesian supply is, that the source must be higher than the wells. Hence, if it be the North Platte, it must come from as far up as Saratoga, but Clarence King in his Geological Government Report describes an anticlinal fold between Saratoga and Rawlins, which prevents it coming from that way.

It is probable that it comes from hills or mountains over 7,000 feet high. It may be fifty miles away; sources have been traced much further than this. Herewith we give the analysis of well No. 1, as made by the Chemist, also the analysis of the mixture of the two as used in Rawlins:

Analysis of the water from artesian well No. 1, Rawlins. Sample sent by Mayor Rasmusson.

	Grains per gallon.
Silica, Si O_2	.676
Iron and Alumina, Fe_2O_3, Al_2O_3	.064
Lithium, Li	Trace
Potassium Chloride, K Cl	.886
Sodium Chloride, Na Cl	20.644
Magnesium Chloride, Mg Cl_2	.298
Magnesium Sulphate, Mg SO_4	7.225
Calcium Sulphate, Ca SO_4	23.799
Calcium Carbonate, Ca CO_3	.268
Total solids	53.860

By E. E. SLOSSON, Chemist.

Analysis of the mixture of the water of the two wells as now used in the City of Rawlins.

	Grains per gallon.
Silica, Si O_2	.57
Calcium Carbonate, Ca CO_3	8.88
Magnesium Carbonate, Mg CO_3	1.07
Sodium Chloride, Na Cl.	26.82
Alkali	19.27
Total solids	56.61

By W. S. ROBINSON, U. P. R. R. Chemist, Omaha.

The following data of the Saratoga artesian well was furnished by J. F. Crawford of Carbon county :

Depth, 55 feet. It flows 50 pallons per minute. The formation was sand and gravel for 12 feet, the rest was sandrock. It was sunk by Harris Bros., and cost about

$100, and is situated on northwest quarter section 4, township 17, range 84 west, Carbon county. It flows freely and is a great success.

THE LARAMIE ARTESIAN BASIN.

There are several artesian wells in and about Laramie. The one on the State University campus was sunk by W. W. Breese in 1891. At my request he saved twenty-eight samples of the borings. The following is a description of them :

40 feet, fine quartz gravel and red sandstone.

80 feet, coarser and a little darker color.

120 feet, No apparent change.

160 feet, color the same, but a little more gravel.

200 feet, about the same as above.

240 feet, a little less gravel than the last two.

280 feet, considerably coarser and large fragments of gypsum.

310 feet, quite a change in color ; lighter red ; no grains of gravel or gypsum perceptible.

458 feet, fine light colored gravel and red sandstone, and some carbonate of lime, giving the whole a mottled appearance ; water was first struck at this depth.

465 feet, a slight change from the above ; hardly any gravel.

480 feet, lighter color than the above ; sandstone and carbonate of lime.

505 feet, coarser grain and darker color.

546 feet, a very decided change ; the borings almost an impalpable powder ; very much lighter color, a beautiful salmon tint ; some carbonate of lime.

570 feet, small chips of dark red sandstone and considerable light colored gravel, giving to the sample a mottled appearance.

595 feet, large chips of gypsum, and red sandstone ; (caving).

630 feet, red sandstone ; no gypsum or gravel.

657 feet, same color, containing a little gypsum.

698 feet, same as above.

733 feet, no apparent change.

825 feet, a remarkable change ; fine grain pinkish sandstone.

870 feet, same as above.

900 feet, very fine slightly tinted sandstone, and some limestone.

940 feet, very fine, lighter than the above; almost white sandstone and carbonate of lime.

970 feet, same as 940.

995 feet, same as above, except slightly reddish tint.

1015 feet, coarser grain, containing carbonate of lime, a light cream color.

There is such a slight difference in some of the samples above, color and fineness being the principal distinctions, that we give also a summary with more marked distinctions:

At 80 feet a change noticed in coarseness of material to 150 feet. From 150 to 300 feet finer and brownish red. From 300 to 560 much lighter colored and finer material, containing a little carbonate of lime; 560 to 590, mottled, coarser, darker, a little carbonate of lime; 590 to 615, coarse fragments of red sandstone and gypsum; 615 to 650, coarse brown sandstone; no gypsum; 650 to 680, coarse and a little gypsum; 680 to 780, medium in coarsness, brown sandstone; 780 to 880, very much lighter and very fine; 880 to 960, almost white, very fine sand and carbonate of lime; 960 to 1015, a little coarser than the above, having about the same amount of carbonate of lime, but a cream color.

There are 40 feet of $7\frac{5}{8}$ inch casing to shut off gravel at the top, and 600 feet of $5\frac{5}{8}$ inch casing. The first flow was struck at a depth of 458 feet; this comes up between the two casings. The second flow was struck at 820 feet. The drilling was continued to a depth of 1,015 feet. No more water was met with. The amount of water, as measured by Prof. B. C. Buffum, flowing at the beginning, was 50,000 gallons per twenty-four hours. The contract

price for drilling was $2,000. The University furnished the casing at a cost of $552.25; total $2,552.25.

Partial Analysis of University Artesian Water.

	Grains per gallon.
Total residue on evaporation	12.130
Soluble in water after evaporation	6.392
Insoluble in water after evaporation	5.738
Silica, $Si\ O_2$	.950
Iron and alumina	.630
Lime, $Ca\ O$	3.750
Magnesia, $Mg\ O$	2.105
Chlorine, Cl	.799

By E. E. Slosson, Chemist.

Two or three miles east of the University I found an outcrop of the same sandstone in which water was struck in the artesian well. This rock dips under the red sandstone (the Triassic formation) at an angle of 6½ degrees, and extends up the hills for three or four miles. I found in this formation the following genera of fossils: viz: Allorisma, Athyris, Bellerophon, Pinna, Productus, Myalina, besides others. These are sufficient to show that this formation belongs to the Carboniferous age. It dips under the Triassic, which is the surface rock at the University, and from the borings seems to be about 825 feet thick. It thins out rapidly towards the hills and the Carboniferous becomes the surface rock, in some places, one and a half miles away. Since it has been maintained by pretty good authorities that the City springs and the artesian wells at Laramie are supplied with water by the Snowy Range which is forty miles distant, I desire to present a few facts here to show that the water does not come from that source, but from the hills to the east. In the first place it is shown by the borings from the artesian

well at the University that the surface rock not far from the springs is identical with the water-bearing rock struck at the University artesian well. The pressure in the well is about the same as the altitude of the outcrop to the east would indicate.

Secondly, if the springs and artesian well derived their sources of water from the Snowy Range they would hold in solution some of the minerals found there, which they do not.

Thirdly, since water tends to seek a level, the pressure would be many times as great as it is, for the Snowy Range is about 4,000 feet higher than the well, while the altitude of the water bearing rock to the east gives about the pressure as measured at the well.

Furthermore, if the Snowy Range were the source, we would expect a better supply and strong flowing artesian wells west of the Laramie river and nearer the source of supply. Many attempts have been made to get artesian water a few miles west of the river but without success. I am informed by W. W. Breese, who has sunk several wells there, that the red rock has never been struck. It must be that there is quite a break, or fault, in the Triassic, also in the underlying Carboniferous formation just east of the river, which would throw them a great depth below the surface, even a short distance west of the river. The average dip of the first lime outcrop of rock, about 2,600 yards east of the University and 80 to 100 feet higher altitude, is 6½ degrces. The dip of the sandstone under this, further up the hill, is the same. Working from the above data, the depth would be close to that at which water was struck, 825 feet.

In answer to one objection made to the supply of

water coming from the hills east of town, viz.: that there is not rainfall sufficient to produce the springs and wells, I would say that this is an assertion without proof. The average annual rainfall for several years taken at Fort Sanders, just south of the city limits, is 13 inches. The rainfall on the hills to the east is greater than this, probably 15 inches or more, and there being such a vast extent of the water-absorbing sandstone exposed on the hillsides, make the conditions in and about Laramie to the east of the river very favorable for artesian water; and it would be much better but for so much water coming to the surface at the City springs, Soldier springs, and the springs at the Jabez Simpson ranch. All these are within a distance of seven miles. These three groups of springs yield at least three million gallons every twenty-four hours; some estimate it much more. There are gullies and dry branches on the hillsides which sometimes become turbulent streams. A little computation will show that twenty or more square miles of porous sandstone, with fifteen inches rainfall coming in contact with it yearly, would furnish as vast a water basin as is exhibited by the springs and wells.

A few words in regard to the snowy range water supply will not be out of place here. The limpid streams that make the Centennial valley so beautiful and luxuriant come from the dripping snows of the mountains fifteen miles distant Some come gurgling and murmuring through canyons of their own chiseling, those deep-cut furrows in the mountain sides. Others originate in immense springs that break forth from underneath the mountains, We call attention to a notable one owned by J. J. Hays. We estimate that fifty feet away from the spring

the stream is two feet deep and five feet wide, moving with a considerable velocity, it being the main branch of the Middle Fork of the Little Laramie river. Properly managed it would irrigate several sections of hay land. This is but a small fractional part of the water that flows out of the Centennial valley through the Little Laramie river, the great outlet of the melting snows of the mountains.

We quote herewith from the Senate Executive Documents, first session Fifty-second Congress, 1891-1892, Vol. IV., Irrigation. This is from the final report of the artesian and underflow investigation and of the irrigation inquiry in pursuance of authority conferred by Congress in 1890 and 1891. Referring to Wyoming:

"There are eighteen artesian wells in the territory, sixteen of them being located at and near Laramie City, one at Cheyenne and one at Rollins." [This should be Rawlins, and refers to the one at the court house.] "There are also a small number of bored wells in the neighborhood of Laramie in which the water rises not quite to the surface and is raised by means of windmills. The water of these wells is used entirely for domestic and stock purposes."

I have visited nearly all the artesian and bored wells on the Laramie Plains, and have given a detailed account of them, so far as I was able to get the data. The deepest and most important well in Albany county is the county well sunk in 1887 in the northern part of the City of Laramie and about three-quarters of a mile in a bee-line northwest from the University well, and on 39 feet lower ground, measured especially for this Bulletin, free of charge, by the City engineer, W. O. Owen. It being on

such low ground, it is impossible to conduct it anywhere, except at a very great expense. The object of sinking this well was to get oil.

A friend of mine, E. G. Gay, of New York, who sunk the oil wells at Bowling Green, Ohio, visited me during this time, and on going down to see the well he remarked that in nine cases out of ten people in boring for oil or gas sought the lowest ground. "What a mistake," said he; "if they only get water it cannot be conveyed anywhere." He made a practice of boring on higher ground and was very successful, being the first one that struck gas in one of those celebrated Ohio regions. He pointed to the grounds of the University as being more suitable prospect grounds, remarking that if only a good flow of water should be struck it could be utilized at a small expense. The two Rawlins wells are also on the lowest grounds in the city.

The county well was sunk by the Nebraska, Colorado and Wyoming Oil and Mining company of Sidney, Nebraska, Edward Elmer in charge. The following is my description of the borings saved by George W. Fox, then county clerk. These samples are at the court house. There were no samples kept until at a depth of 730 feet.

730–927 feet, red sand rock.

927–1000 feet, a decided change, a vety fine, almost white sandstone.

1000–1015 feet, pinkish colored sandstone.

1015–1030 feet, yellowish fine-grained sandstone.

1030–1090 feet, white sandstone and carbonate of lime.

1090–1195 feet, salmon colored sandstone and carbonate of lime.

1195–1200 feet, a cream color; marked magnetic; oil, and sand.

1200–1215 feet, lime rock below the oil rock; red sandstone, marked highly magnetic.

1215–1225 feet, red sandstone, over 1,200 feet deep.

FORMATION

Judson, Sutphin & Co.'s Artesian Well.

stick had been left in it and was colored as black as

ink by the sulphur in the water. This well was the only one of the group that had an odor of sulphur. The temperature was 56 degrees.

The big flowing well is situated just outside the grounds, and is 140 feet deep, and at first boiled eight and one-half inches above the $5\frac{5}{8}$ inch pipe. It is about as strong as ever. I investigated all of these wells in company with N. E. Stark, on August 18, 1894. A circle described with a radius of a quarter of a mile would enclose all of these wells. The one at the house is pumped by a windmill. The temperature of the water was 46 degrees and that of the air, in the sunshine, was 90 degrees. Two others were about 175 yards from the house. In one the water stood within two feet of the top of the pipe. This well is less than 200 feet deep, all red rock, and in the other, 30 yards distant, and eight feet higher ground, water stood about six feet from the top. This is the deepest of the group, 312 feet, all limestone. The temperature of these two was 58 degrees, while the sun was shining against the top of the pipes, with a temperature of 90 degrees. In the spring time the lower of these two wells becomes a flowing well. The three wells were drilled by Breese & Cokefair, in 1888. Mr. Stark informed me that, if the big flowing well were plugged, the one within the fair grounds, being nearest to it, would flow within three hours. The experiment had been tried, and I believe that if both were plugged, those at the house, a half a mile away, would flow. We purposed taking the temperature of the big flow, but could not approach it within twenty feet. It was boiling up a foot or more above the pipe and produced a large reservoir. It was partially plugged, and would boil nearly as high if it were

not. The remaining well is in the northeast corner of the stock barn, near the house. Water stood within three feet of the top of the pipe. The temperature was 54 degrees, that of the air was 74. This well was drilled by J. J. McCutcheon, and was at first a flowing well, but there was so much ice around it in the winter, that Mr. George cut it off, and in the spring when he removed the plug, it ceased to be a flowing well. I attribute this to the fact that the supply is from a secondary basin, having quite a limited surface drainage, and the big flow is a sufficient vent for all the water in the water-bearing stratum except in the spring of the year, when there is more abundant snow and rain.

We call attention to a few facts pertaining to the supply of water in the vicinity of the fair grounds: The City springs are situated in southeast quarter, section 35, township 16, range 73 west, in a beeline south in southeast quarter, section 23, township 15, range 73 west, the Soldier springs break forth in their crystalline beauty, and exactly south in section 2, township 14, range 73 west, is the ranch of Jabez Simpson, noted for its excellent springs. All these are within a distance of seven miles.

In the southeast part of section 14, about a mile north of Soldier springs, is a spring five feet below the surface, coming from a dark red sandstone, so mixed with lime, that it seems to be a connecting link between the Triassic and Carboniferous formations. The temperature on August 22, was 52 degrees and the air was 75 degrees. The water is quite soft. Five years ago this spring made a pond 50 by 100 yards, giving source to quite a large running stream. There is an exceedingly interesting cave about half way on a north and southeast line between

the spring and Mr. Pelton's house. It was formed nine years ago. A subterranean flow of water was the cause. Although there is no water in sight, we are quite certain that it was thus produced. It is about fifteen feet across the top and fifteen feet deep. It is a perfectly dry red rock formation, but the most venturesome person would hesitate to go down into it without clinging to a strong rope. The sides are almost perpendicular. It is probable that this caving dammed up the underground current and forced it out above, forming the spring mentioned. Five years ago there was a lake on the northeast quarter of section 14, over a mile southeast of the fair grounds. It was between two and three hundred yards in diameter. But this lake dried up, and the stream flowing from the above mentioned spring was lost at the same time; and has found its old underflow or another one. These facts substantiate the proposition laid down, when speaking of the wells on the George ranch. It is very probable that water can be struck at a depth of 160 feet, anywhere east of the railroad, and within four or five miles south of the city, but many more wells in the vicinity of the flowing ones, would undoubtedly stop their flow. Scores of wells could be sunk that windmills could not exhaust.

Clark W. Pelton has two wells on his ranch, in the southwest quarter of section 10, township 15, range 73 west. The first was sunk in August, 1889, and is 333 feet deep; the rock passed through was all red rock, with an occasional seam of gypsum; sunk by Breese & Cokefair. It cost $1.50 per foot for the first 200 feet, and $2 for the balance. Total cost of drilling was $566. Mr. Pelton furnished the $5\frac{5}{8}$ casing. At a depth of 120 feet they struck a vein of water, which rose to within 60 feet of the

top, but gradually increased as they went down, to within seven feet of the top of the pipe. Quick sand was struck at a depth of 333 feet. This is an excellent quality of water. The temperature on August 22, was 47 degrees; the air was 72.

We give herewith an analysis of the water, as made by the chemist of the station:

Partial Analysis of Water from Pelton's Artesian Well.

Water highly impregnated with hydrogen sulphide, H_2S.

	Grains per gallon.
Total residue on evaporation	60.053
Silica, SiO_2	1.498
Iron and alumina	.081
Lime, CaO	15.512
Magnesia, MgO	6.181
Sulphuric acid, SO_3	18.375

By E. E. Slosson, Chemist.

The chemist intends in the near future to issue a bulletin on the analyses of the water of the artesian wells, also of irrigation water. Time would not permit of any more analyses for this bulletin.

Mr. Pelton has two tanks, one 24 feet long by 4 feet wide and 2 feet deep; the other is 8 feet long, 3 feet wide and 3 feet deep, capacity 264 cubic feet, and hold nearly 1,500 gallons. By pumping these full, and allowing it to stand it becomes sufficiently warm for irrigation. Mr. Pelton has a garden of about one acre irrigated by this well. Two hundred yards to the north and across the road in the pasture is another well, sunk this year. The water stands to within thirty inches of the top of the eight inch pipe. The formation is all red rock. This well being on a rise of ground, a small ditch is dug nearly three feet deep, leading to an artificial pond, hence this negative well is converted into a feebly flowing well. The

temperature was 52 degrees on August 22, while the atmosphere was 72 degrees.

Mr. Homer's well, given in the table, is the furthest from the hills of any sunk in this basin, and since the rock becomes thicker as the distance from the hills increases, it is a question as to the depth at which flowing water could be struck. If we were certain that the dip does not change, it could be figured out satisfactorily. The angle between the University and the county well is some less than the dip of the rock on the hills to the east. It is very probable that it is so on Mr. Homer's ranch. I

Tabulated Description of Wells on the

OWNER	DRILLED BY	Depth.	LOCATION.
		Feet.	
S. W. Downey, Laramie.....	W. W. Breese.....		Sherrod's Addition, Laramie
O. D. Downey, "	G. B. Bariana	166	Sec. 4, Tp. 15, Rg. 73 W., Albany Co.
" " "	J. J. McCutcheon..	170	" " " "
" " "	" " .	531	" " " "
S. W. Downey, "	" " ..	380	Sec. 1 or 12, Tp. 18, Rg. 78 W., Carbon Co ....
Oxford Ranch, Red Buttes.	" " ..	540	......
" " " " ..	" " ..	350	......
S. W. Downey	....	160	Tp. 13, Rg. 75 W.
Geo. H. Hunt, Laramie	Ryan Bros.........	65	Sec. 10, Tp. 15, Rg. 73 W.
" " " ...	" "	220	" " "
Thomas McHugh	G. B. Bariana......	112	NE ¼ Sec. 5, Tp. 15, Rg. 73 W.
" "	Ryan Bros.........	117	NE ¼ Sec. 8, Tp. 15, Rg. 73 W.
*Jabez Simpson.....	G. B. Bariana......	112	SE ¼ Sec. 5, Tp. 15, Rg. 73 W.
Peter Hanson...............	....	86	NW ¼ Sec. 8, Tp. 15, Rg. 73 W.
Robert H. Homer...........	W. W. Breese ...	1118	Soc. 12, Tp. 14, Rg. 74 W.
Laramie Cemetery	Breese & Cokefair..	800	......
George Montague, Laramie..	" "	150	Northern part of Laramie
J. S. Braskett...............	" "	225	Downey Addition
" "	" "	100	" "
A. T. Holmes.....	" "	....	" "
Judson, Sutphin & Co.......	" "	....	" "
W. H. Holliday Co., Laramie.	G. B. Bariana......	80	Sec. 6, Tp 15, Rg. 74 W.
Ryan Bros...	Ryan Bros.........	85	Northern part of Laramie

*First well sunk in the State.

believe that he could have a flowing well at a depth of 1,500 feet. At any rate such a depth would be of great public interest, as it would show whether water can be had at that depth, and in what quantities, and it would prove whether there is any oil or gas in that distance. Mr. Homer says he would have gone down to that depth had the machinery been suitable.

We have spoken of attempts to get artesian wells west of the big Laramie river. We think that the following description from our various data will be instructive and quite appropriate: Oliver Mansfield, living on sec-

Laramie Plains, not given elsewhere.

Time.	Feet of Casing	Formation.	Temperature of water in summer.	Flow per 24 hours.	Cost of Drilling.
1887	....	Red rock.	45°	3927 gallons	....
1882	....	....	....	At first 1-inch pipe; now negative	....
1886	....	....	45°	8640 gallons	....
1889	....	....	....	Negative well	....
1886	....	11-foot vein of coal at 313 ft.	....	Filled a 5 inch pipe	....
1888	....	Gray sandrock	....	Filled a 2-inch pipe	....
....	....	....	....	Being on high ground, a deep ditch made it flow.	... .
....	....	....	....	Good flow	....
1891	...	....	....	Negative; water 18 inches from top. The windmill sometimes pumps it dry.	....
1892	....	....	....	Negative; water 18 inches from top. The windmill does not affect amount.	....
1887	37	....	45°, air 77°	1080 gallons	$ 155 50
1891	....	....	44°, air 76°	831 "	163 80
1878	...	....	46°, air 82°	864 "	....
...	....	....	46°, air 80°	Negative well	....
1891	1060	Red rock.	....	Negative; water 4 feet from top. The windmill does not lower it.	1986 00 Casing $800
1888	....	....	....	2-inch pipe	....
1888	....	Red rock.	....	Negative; water 6 feet from top	....
1888	....	" "	....	1-inch pipe flow	....
1888	....	" "	....	Small flow	....
1889	....	" "	....	Small flow	... .
....	...	....	....	Negative; water 9 feet from top	....
....	....	....	....	Negative well	....
....	....	....	48°	840 gallons	....

tion 20, township 14, range 75, sixteen miles southwest of the city, and one mile west of the Big Laramie river, commenced to bore a well in 1890. The first nine feet they passed through gravel, then struck a dark shale. At the depth of 65 feet a small stream of very salt water was met with, and a little further down the water had a very strong petroleum odor, and at 245 feet gas was struck. I visited the well ; we plugged it with a block, boring a half inch hole through it, and lighted the gas, which produced a three or four inch flame that continued to burn for several hours. They tried the experiment two or three different ways, with the same result.

At a depth of 440 feet salt water raised to within four feet of the top of the pipe. The drilling was continued to a depth of 502 feet, making 493 feet of shale. It was impossible to tell how much thicker it was. The work was stopped on account of the great expense of sinking. The work was done by W. W. Breese.

We herewith quote from the Senate Report on Irrigation, and from the data therein given will work out the problem as to how much land the University well would irrigate, under proper management, trusting that it will be of some practical utility:

"B. S. La Grange, irrigation expert, estimates that: "In Colorado the flow of a cubic foot per second, throughout the irrigation season, is sufficient for about 100 acres ; but with the constant flow from an artesian well, the duty of water in experienced hands will be much greater ; it is safe to say 200 acres per second foot." He says further, "That in Colorado, it costs to bring water to one's land, from the streams, $3 to $5 per acre. In Dakota, the constant flow will allow each cubic foot per

second to supply 200 acres, under good management. If a well flowing six cubic feet per second can be put down for $2,500, it is less than it is with us, where we bring our water from the streams in ditches."

The flow from the University well was at first, 50,000 gallons in twenty-four hours, or 2,083⅓ gallons in one hour. Dividing this by 3,600, the number of seconds in an hour, it gives the decimal, .5787 of a gallon per second. There are, approximately, 5½ gallons in a foot. Divide this last decimal by 5½, and we get the decimal, .10522 of a cubic foot that the well flows in a second. If one cubic foot per second will irrigate 200 acres in Dakota, this decimal part of a cubic foot will irrigate such a part of 200 acres, which is 21 acres; but we believe that this estimate is too high for Wyoming, where the soil is usually more gravelly and porous, and containing less clay, and the evaporation, due to elevation, being greater, we would deduct at least 33⅓ per cent, some say more. This would give a result of 14 acres. But in order to do this a reservoir would have to be built to store the water.

Corthell and Bevans had one sunk by J. J. McCutcheon in 1889, about one mile north of the cemetery, on the bottom lands. The formation was red rock and full of seams. They went down 313 feet and got a flowing well.

There is a well at the hospital, in the eastern portion of the city limits, something less than 200 feet deep; drilled by G. B. Bariana. At first it was a flowing well, but after a time it sunk down 40 feet or more.

McCutcheon & Cokefair put down a well for Ora Haley, on the Oasis ranch, near Wyoming station, in 1892. Water kept rising in the pipe as they went down, and at the depth of 89 feet it stood eighteen inches from the top.

It is probable that at 30 feet more, they would have had a flowing well. I call it a negative artesian well.

There are several shallow wells, about 28 to 30 feet deep, on the Sartoris Willan Home ranch, on a branch of the Little Laramie river. There is one of such excellent quality of water, and being a negative well, it deserves special mention. It is 500 feet deep, and water rises within four feet of the top, and being on ground 25 feet higher than where the barns are, a ditch could be sunk so as to convey the water to the barns, in which case this would be a flowing or a positive artesian well. I class it now as a negative artesian well. A windmill does not exhaust it. Geo. Morgan furnished the facts for the above description.

The W. H. Holliday Co., had a well sunk in the northern part of the Sherrod addition to Laramie, about a half a mile nearer the center of the city than the flowing well already described, in the same addition. They went down 189 feet, and it was quite a disappointment that they did not get an artesian well, since there are several within a mile. There was some mismanagement in handling the casing, etc. It illustrates that there is some uncertainty of getting water, even in a well known artesian basin.

We find in the September number of the *American Agriculturist*, the following fact, which is of sufficient interest for insertion here:

"Of late years many of the market gardens near Salt Lake City are irrigated from artesian wells, which have an average discharge of 26 gallons per minute. In 1890 there were 2,000 of these drive-wells in the territory,some

of which have a volume sufficient to irrigate five to seven acres."

Frequent mention has been made in this bulletin of artesian wells ceasing to flow. Oftentimes the pipes become obstructed by sand or gravel or other material getting in and choking up the pipes until the flow ceases. In such cases one would be led to believe that the sources of supply had failed. But in artesian regions, we often hear of pipes being cleaned, and the flow restored. We must distinguish between the choking up of a well and of the supply being actually cut of by too many wells being in close proximity.

Official Analyses of Union Pacific Railway Wells.

After collecting the m[illegible] for the information thus far given in this bulletin, I interviewed Col. S. W. Downey, who has had more artesian wells sunk than any other individual in the state. He at once dictated a letter to E. Dickinson, general manager of the Union Pacific Railway Company, who by correspondence with the various departments, has enabled us to present the following, concerning the wells sunk by the Union Pacific Railway Company in Wyoming.

We are under special obligations to T. A. Davies, division master mechanic, for particular facts furnished by him and for having the data type-written for the publishers.

OMAHA, Nebr., August 24, 1894.

Mr. J. H. McConnell, Superintendent of Machinery:

DEAR SIR:—Enclosed please find analyses of water from different artesian wells in Wyoming. I have put on each analysis all the information which there is in this office.

In regard to the formation through which the drill passed, I should think Mr. Davies, at Laramie might possibly have a record. No record of the flow is ever sent here.

Yours truly,

W. S. ROBINSON, Chemist.

REPORT OF CHEMICAL TEST.

OMAHA, Neb., April 26, 1893.

Sample of water from Rawlins, Wyo., received April 14th, 1893, from well No. 1; drilled in 1883, 402 feet deep; cased 300 feet.

One gallon contains in solution :

	Grains.
Silica	0.93
Carbonate of lime	8.14
Carbonate of magnesia	0.97
Sulphate of lime	5.53
Sulphate of magnesia	7.13
Sulphate of soda	6.33
Chloride of soda	12.48
Total solids	41.51

In September, 1888, the total solids of this well were 24.3 grains per gallon.

W. S. ROBINSON, Chemist

Well No.1, at Rawlins, drilled through 20 feet of soil. From 20 to 310 feet, chalk rock. From 310 to 350 feet, hard conglomerate rock. Water is found in conglomerate rock and gravel of smooth, round and oval worn pebbles. Depth of well, 360 feet.

Well No. 2, same conditions of rock. Wells are only 25 feet apart. Well No. 2 furnishes 4,000 gallons per hour.

REPORT OF CHEMICAL TEST.

OMAHA, Neb., November 15th, 1893.

Sample of water received November 13th, 1893, from Rawlins, Wyoming. New City well, 471 feet deep. This well flows 18,000 gallons per hour through a 6⅝ inch casing.

One gallon contains in solution :

	Grains.
Carbonates of lime and magnesia	14.20
Sulphates of lime, magnesia and soda	24.06
Chloride of soda	19.40
Total solids	57.66

W. S. ROBINSON, Chemist.

REPOR… …MICAL TEST.

…AHA, Neb., October 31, 1888.

Sample of water, art… …ceived September 28, 1888, from Rawlins, Wyoming.

One gallon contains

	Grains.
Carbonate of li…	7.51
Carbonate of m…	0.86
Sulphate of lime	1.00
Sulphate of magnesia	4.34
Silica	0.54
Alumina	0.09
Sulphate of soda	2.56
Carbonate of soda	0.28
Chloride of soda	7.06
Total solids	24.34

This well (No. 1) is 402 feet deep and cased for 330 feet.

H. B. HODGES,
Chemist and Engineer of Tests.

REPORT OF CHEMICAL TEST.

OMAHA, Neb., May 2, 1892.

Sample of water, artesian well, received April 27th, 1892, from Bitter Creek, Wyoming.

One gallon contains in solution:

	Grains.
Silica	0.23
Carbonate of lime	0.77
Sulphate of soda	25.05
Carbonate of soda	48.90
Chloride of soda	5.59
Silicate of soda	0.50
Total solids	81.04

This well is cased for 639 feet.

W. S. ROBINSON, Chemist.

BITTER CREEK.—This well has a capacity of 33 gallons per minute natural flow at surface, and has a head pressure of 23 pounds per square inch at surface. By pumping, well will furnish 2,000 gallons per hour. There is 69 feet surface deposit or soil, then 12 feet shale rock and small vein of coal. From 80 feet to 580 feet the formation is black shale, with small vein of sand rock from 580 feet to 586 feet, with shale again to 680 feet, when sand rock is struck, which furnishes water for present flow. Continued down to 1250 feet through shale, where a thin streak of sand rock gave another flow of 3 gallons per minute. This well has 560 feet of 7½-inch casing.

REPORT OF CHEMICAL TEST.

OMAHA, Neb., May 5, 1892.

Sample of water, artesian well, received April 25, 1892, from Red Desert, Wyoming.

One gallon contains in solution:

	Grains.
Silica	0.06
Carbonate of lime	4.13
Carbonate of magnesia	2.40
Sulphate of Magnesia	1.51
Sulphate of soda	68.25
Chloride of soda	2.38
Carbonate of soda	11.97
Total solids	90.70

This well is cased for 515 feet.

W. S. ROBINSON, Chemist.

Red Desert No. 2, drilled in 1882, depth 763 feet, cased 515 feet with 5⅝-inch casing. Soil drilled through about the same as Bitter Creek. Is pumped at a depth of 300 feet from surface with 3½-inch tubing and 3¼-inch pump barrel. Produces 1000 gallons per hour.

REPORT OF CHEMICAL TEST.

OMAHA, Neb., August 2, 1889.

Sample of water, artesian well, received July 30, 1889, from Carbon, Wyoming, from bottom of well 325 feet deep.

One gallon contains in solution:

	Grains.
Clay	1.17
Carbonate of lime	13.56
Sulphate of lime	1.70
Carbonate of magnesia	1.50
Sulphate of Magnesia	11.37
Sulphate of soda	25.94
Chloride of soda	1.48
Total solids	56.72

In July, 1890, this well had reached a depth of 735 feet and contained 123 grains of mineral matter in solution. The well is not used by the company.

H. B. HODGES,
Chemist and Engineer of Tests.

This well was drilled in sand rock the entire depth, with an occasional vein of shale two or three feet thick. Drilled to 743 feet deep, with 673 feet of 5⅝-inch casing.

REPORT OF CHEMICAL TEST.

OMAHA, Neb., May 7, 1892.

Sample of water, artesian well, received April 27, 1892, from Fillmore, Wyoming. This well is 1353 feet deep, cased 882 feet with 5⅝-inch casing.

One gallon contains in solution:

	Grains.
Silica	0.32
Carbonate of lime	2.31
Carbonate of Magnesia	1.51
Sulphate of soda	24.35
Chloride of soda	2.98
Carbonate of soda	22.92
Total solids	54.39

W. S. ROBINSON, Chemist.

REPORT OF CHEMICAL TEST.

OMAHA, Neb., January 5th, 1889.

Sample of water received December 13th, 1888, from Harpers, Wyoming. Well 450 feet deep; drilled in 1882; pump 225 feet below surface. Water has been found by experience to be corrosive when cold, and to foam in the boilers. Drilled 425 feet, with 293 feet of 5⅝ inch casing.

One gallon contains in solution:

	Grains.
Carbonate of lime	3.23
Carbonate of magnesia	1.06
Clay	0.39
Chloride of soda	1.95
Sulphate ot soda	49.70
Bicarbonate of soda	5.14
Total solids	61.47

H. B. HODGES, Chemist and Engineer of Tests.

REPORT OF CHEMICAL TEST.

OMAHA, Nebr., May 14th, 1889.

Sample of water, new well, received May 10th, 1889, from Wamsutter, Wyoming. Artesian well cased 500 feet.

One gallon contains in solution:

	Grains
Carbonate of lime	3.13
Chloride of soda	2.30
Sulphate of soda	54.53
Total solids	59.96

H. B. HODGES,
Chemist and Engineer of Tests.

Wamsutter well No. 2, drilled 725 feet, cased 500 feet with 5⅝ casing. Will furnish 3,750 gallons per hour.

Wamsutter well No. 3, formation as follows:

140 feet soil or surface deposit.

140 to 160 feet, brown sandstone, very soft.

160 to 165 feet, small vein of coal.

165 to 200 feet, light colored shale.
200 to 201 feet, very hard streak, brown sandrock.
201 to 215 feet, light colored shale.
215 to 235 feet, cream colored chalk rock and soapstone.
235 to 240 feet, vein of coal.
240 to 258 feet, light gray colored shale.
258 to 259 feet, hard streak of rock.
259 to 270 feet, soft chalklike rock.
270 to 271 feet, small vein of coal.
271 to 280 feet, light gray material.
280 to 282 feet, very hard rock.
282 to 340 feet, light gray shale.
340 to 345 feet, dark brown rock.
345 to 350 feet, vein of coal.
350 to 360 feet, dark brown rock.
360 to 420 feet, light gray shale, somewhat gritty.
420 to 435 feet, dark brown colored rock, hard and tough to drill.
435 to 450 feet, vein of coal.
450 to 485 feet, brown sand rock.
485 to 490 feet, vein of coal.
490 feet to bottom of well, shale.

This well has in 650 feet of 8-inch casing. Water vein at 700 feet to 715 feet, and is pumped with a deep well pump. Will furnish 4,500 gallons of water per hour.

UNIVERSITY OF WYOMING.

Agricultural College Department.

Wyoming Experiment Station,

LARAMIE, WYOMING.

BULLETIN NO. 21.

JANUARY, 1895.

THE GRAIN SMUTS AND POTATO SCAB.

BY THE BOTANIST.

Bulletins will be sent free upon request. Address: Director Experiment Station, Laramie, Wyo.

Wyoming Agricultural Experiment Station.

UNIVERSITY OF WYOMING.

INTRODUCTION.

BY THE DIRECTOR.

For the past four years the Wyoming Agricultural Experiment Station has sent out each year a crop report as a bulletin, in order to acquaint the farmers and ranchmen of Wyoming with the best varieties of farm and garden crops, and also the best kind of crops for Wyoming, taking into consideration the climate and altitude. We have endeavored to solve these questions in the interests of the ranchman and farmer, so that they might intelligently cultivate such crops as may be successfully grown, and at the same time receive a good profit for their labor.

By the aid of our farm superintendents, who have kept the scientific notes, and especially by the efficiency and care of Prof. B. C. Buffum, Agriculturist and Horticulturist, aided by his assistant, Mr. H. S. Kendall, we are able to present the results of 1894 on the various experiment farms. If our farmers and ranchmen will be governed by the suggestions found in this bulletin, we are quite sure that it will result to their advantage.

certained from the records kept at Ft. Sanders, three miles south of Laramie, from the year 1869 to 1878, the average precipitation being for that time 12.92 inches. In 1894 there were only 7.63 inches at this Station, being some over half the normal amount, but nearly all of this fell during the growing season. There were 6.84 inches rain-fall from April 1st to October 1st, distributed as follows:—April, 1.51 inches; May, 0.42 inches; June, 0.64 inches; July, 1.41 inches; August, 1.26 inches; and September, 1.60 inches. The greatest annual precipitation recorded in the State by the Observers who report to us, was from Sundance—19.99 inches. In the month of June 4.16 and in May 3.18 inches fell at that place.

The largest monthly rain-fall recorded was at Inyan Kara during the month of June, viz: 5.01 inches.

At Laramie the greatest amount during any single storm was 0.69 inches in July. At Lander, 1.11 inches in March. At Saratoga, 0.80 inches in March. At Sheridan, 1.00 inch in March. At Wheatland, 1.25 inches in June and July. At Sundance 1.62 inches in May. Laramie, Sundance and Wheatland combined had 37.75 inches precipitation in 1894 and 26.82 inches in 1893. At Laramie and Wheatland it was nearly double the preceding year, while at Sundance it was nearly 21 per cent. more than in 1893. At Lander, Saratoga and Sheridan it was 35.94 inches against 38.74 inches the preceding year, eah station sharing about equally the small difference.

The mean relative humidity or per cent. of moisture at Laramie was lower than the two previous years, being 63.7 in 1892 and 56.9 in 1893, and 56.4 in 1894. June was the driest month, with only 43.4, and May, October and No-

vember were nearly as dry. The mean dew-point was some higher.

EVAPORATION AT LARAMIE.

Evaporation from water surface is measured by means of a Hook Gauge, measurements being taken every day that the water is not frozen. A tank of galvanized iron holding one cubic meter of water is used. Care is taken to keep the tank nearly full, that evaporation may not be interfered with. Evaporation can not be accurately obtained during the winter months. For six months from April 26th to October 27th, it was 37.166 inches. During the time the water was not frozen, it was as follows:

April 26 to 30	0.906
May	6.060
June	7.492
July	6.690
August	6.276
September	6.436
October 1 to 27	3.306

EXPLANATION OF TABLES.

Temperature.—The mean temperature at the Experiment Farms is taken from the maximum and minimum readings. At Bates' Park (Freeland) the observations are taken by Mrs. C. M. Cheney three times daily, at 7 a. m., 2 p. m. and 9 p. m., and the mean for each day is found by the formula $\frac{7+2+9+9}{4}$

At Inyan Kara the observations are taken by S. A. Young.

At Dobin Springs (Casper) the observations are taken by Martin J. Gothburg.

At both places readings are taken twice daily, at 7 a. m. and 7 p. m. The mean is obtained by dividing the sum of the daily readings by two. This probably gives results a little too high for summer months, but nearly as close to the actual mean in the cold months as that from the maximum and minimum readings, since during these months the minimum temperature usually occurs near 7 o'clock a. m., and the maximum between 2 and 3 o'clock p. m. The daily range of temperature is the difference between the maximum and minimum readings.

In Table IV the records of the Anemometer are not complete, as the instrument was out of order for nearly a month. Consequently we recorded the velocity for all the months except September, but the annual mean we could not give.

The precipitation at each Experiment Farm given in Table V is observed by the Superintendent. The record for Cheyenne was furnished by the Chief of the State Weather Service. For Bates' Park (Freeland) by Mrs. C. M. Cheney, for Trelona by James Jackson, for Inyan Kara by S. A. Young, for Hat Creek by Andrew Falconer, for Sybille by A. E. Bridger, for Dobin Springs near Casper by Martin J. Gothburg. The observations at Laramie were made by the Assistant Meteorologist of the Experiment Station, Fred Nelson. Thanks are due to all these observers for the interest taken and time spent in furnishing the records.

TABLE I. TEMPERATURE. 1894

PLACE.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
Laramie	19.9	16.2	29.4	39.1	52.3	55.8	63.2	62.2	51.8	44.4	22.8	21.5	39.9
Lander	21.5	17.9	32.6	43.5	55.5	60.9	66.7	66.7	52.9	45.7	36.9	20.3	43.4
Saratoga	18.2	13.3	29.6	40.0	51.4	56.6	64.5	62.9	50.6	42.6	34.5	19.6	40.3
Sheridan	12.4	9.3	27.7	47.5	55.5	63.2	68.3	68.5	54.3	45.6	38.1	22.6	42.8
Sundance	13.2	13.8	26.6	42.2	54.0	62.1	66.7	68.9	54.2	44.9	33.7	27.1	42.3
Wheatland	25.9	23.1	36.7	47.8	58.4	64.1	71.4	70.7	63.2	48.9	*	*	
Freeland			28.7	39.2	51.0	57.0	65.1	65.5	49.6	42.3	32.4	24.4	
Inyan Kara			27.9	43.8	58.3	67.7	70.7	72.5			32.2	20.8	
Little Horse Cr'k			30.9	46.5	60.9	66.7	71.1	68.4	57.0	45.8	36.8	24.0	
Dobin Springs						65.7	71.3	72.1	57.4	50.0	39.5	29.6	

* Instruments broken. No record kept for November and December.

TABLE II. DAILY RANGE OF TEMPERATURE. 1894

PLACE.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
Laramie	19.9	23.1	19.8	23.2	26.3	28.7	29.2	30.0	28.8	26.5	26.7	23.7	25.5
Lander	24.3	23.8	21.8	22.5	24.1	23.0	34.3	35.9	29.2	33.3	33.7	27.2	27.8
Saratoga	22.8	26.2	20.1	25.1	28.0	29.4	31.4	34.7	29.1	42.8	28.7	29.4	29.0
Sheridan	25.3	30.6	24.5	29.1	29.7	26.7	32.5	38.9	32.5	32.5	27.0	30.3	30.0
Sundance	18.9	23.6	24.1	21.3	26.4	25.6	29.6	30.5	26.8	21.6	19.8	19.1	23.9
Wheatland	32.9	30.6	22.8	25.2	28.1	25.8	31.3	30.0	37.8	34.6	*	*	29.9

* November and December missing. Instrument broken.

Wyoming Experiment Station.

TABLE III.

Weekly Means of Soil Temperatures.

LARAMIE. 1894.

Week ending—	Air Temperature.	3 Inches	6 Inches	12 Inches	24 Inches	36 Inches	72 Inches
January 6	14.6	20.9	23.0	26.1	30.5	33.3	39.6
" 13	18.2	19.8	20.9	23.0	27.8	31.6	38.6
" 20	21.8	25.0	26.2	27.4	29.4	31.2	37.6
" 27	13.3	20.3	21.9	24.1	28.0	30.6	36.9
February 3	16.0	22.2	23.6	24.9	27.4	29.8	36.3
" 10	14.8	20.3	22.0	24.1	27.2	29.5	35.7
" 17	10.6	17.3	19.0	21.0	25.2	28.5	35.0
" 24	5.7	20.0	21.4	23.1	26.1	28.4	34.6
March 3	27.3	28.3	28.4	26.6	26.7	28.5	34.3
" 10	23.6	29.5	30.2	29.5	29.5	30.1	34.1
" 17	36.7	37.9	37.7	34.8	31.7	31.4	34.4
" 24	18.9	33.0	34.6	34.7	34.3	34.1	34.3
" 31	24.7	32.5	33.1	32.9	33.2	33.8	35.8
April 7	35.0	36.9	37.6	36.3	34.9	34.8	36.1
" 14	36.4	41.0	42.1	41.1	38.7	37.4	36.9
" 21	34.9	39.8	40.6	40.4	40.0	39.3	38.1
" 28	44.8	46.4	47.2	45.7	41.6	40.2	38.9
May 5	41.0	45.9	47.5	47.1	44.3	43.3	40.2
" 12	51.0	54.5	55.6	53.9	48.8	46.5	41.8
" 19	50.7	54.3	55.2	54.6	51.3	49.4	43.7
" 26	49.6	54.5	56.4	55.7	52.1	50.4	45.3
June 2	53.1	57.4	58.1	57.1	54.2	52.3	46.6
" 9	52.7	57.7	58.5	57.6	54.9	53.1	47.8
" 16	59.6	63.2	63.6	61.5	57.3	54.9	48.9
" 23	58.8	64.1	64.8	62.6	59.1	56.9	50.4
" 30	60.8	63.7	64.3	62.6	59.6	57.8	51.6
Forward	874.6	1,007.4	1,033.5	1,028.4	1,003.8	1,017.1	1,030.5

TABLE III—*Continued.*

WEEK ENDING—	Air Temperature.	3 Inches	6 Inches	12 Inches	24 Inches	36 Inches	72 Inches
Forward	874.6	1,007.4	1.033.5	1,028.4	1,003.8	1,107.1	1,030.5
July 7..........	60.2	65.9	66.1	64 8	61.3	59.0	52.6
" 14..........	65.6	69.4	70.7	68.5	63.3	60.3	53.6
" 21..........	62.0	67.8	69.2	67 4	63.9	61.5	54 7
" 28..........	64.8	70.1	70 9	68.5	64.4	61.8	55.5
August 4........	59.9	62.4	64.7	65 2	63.7	62.1	56.2
" 11.......	61.8	64.2	65.6	64 5	61.8	60.3	56.2
" 18.......	63.6	69.4	70 6	68.1	64.2	61.7	56.4
" 25.......	59.8	67.8	69.3	67 5	64 5	62.5	56.9
September 1.....	57.7	67.9	69.3	67.3	64 4	62.4	57.3
" 8.....	51 6	60.5	62.5	63 2	62.5	57.4	61.8
" 15....	47.2	53.9	55.3	56 5	57.4	57 9	56.7
" 22....	49.9	56.5	57.8	57.1	56.1	56.1	55.5
" 29....	47.4	55.0	56.7	56.8	56.2	55 9	54 7
October 6.......	42.1	47.5	49.2	50.4	52.1	53.3	54.0
" 13.......	40.0	46.5	48.0	48.5	50.0	50.9	52.7
" 20.......	43.6	49.5	50.6	50.1	50.0	50.3	51.7
" 27.......	41.2	46.0	47.3	47 9	48.8	49.5	50.9
November 3.....	32.6	38.5	40.7	42.7	45.5	47.4	50.1
" 10....	36.0	40 0	41.4	42.1	43.7	45.2	48.9
" 17....	30.5	37.3	38.7	40.4	42.7	44.3	47.9
" 24....	30.9	32.3	34.0	36 1	39.6	42.1	45 3
December 1.....	31.8	35.5	36.6	37.3	39.1	40.9	45.6
" 8.....	22.9	28.2	29.6	32.1	36.3	39.1	44.6
" 15....	20.3	25.5	27.1	29.4	33.6	36.7	43.3
" 22 ...	30.5	29 4	30.3	30.9	33.2	35.4	42.0
" 29....	5.7	23.1	24.7	28.1	32.4	35.1	41.0
Sums....	2,034.2	2,316 5	2.380.4	2.379 8	2,364.5	2,366 2	2,379.6
	39.1	44.5	45.8	45.8	45.5	45.5	45 7

Table IV. LARAMIE. 1894

MONTH.	Relative Humidity. Highest.	Relative Humidity. Lowest.	Relative Humidity. Mean.	Dew-Point. Highest.	Dew-Point. Lowest.	Dew-Point. Mean.	Barometer. Highest.	Barometer. Lowest.	Barometer. Mean.	Wind. Greatest Velocity.	Wind. Miles.	Wind. Direction	Terrestrial Radiation. Highest.	Terrestrial Radiation. Lowest.	Terrestrial Radiation. Mean.
January	100.0	34.8	72.4	23.5	-17.0	8.7	23.152	22.531	22.887	48	11,234	S. W.	8.8	1.5	4.8
February	100.0	27.7	66.1	19.2	-18.0	3.3	23.254	22.554	22.920	44	9,927	S. W.	7.7	0.4	4.5
March	100.0	21.6	64.5	34.2	-9.5	14.8	23.292	22.552	22.919	60	12,265	S. W.	8.3	0.3	3.6
April	100.0	20.7	61.3	35.1	7.7	23.9	23.276	22.675	22.992	66	11,487	N. W.	7.5	0.3	3.1
May	86.3	13.5	49.7	44.5	9.0	29.3	23.315	22.705	23.058	60	12,137	S.	6.5	0.5	3.1
June	87.0	10.6	43.4	48.2	12.6	32.8	23.236	22.827	23.062	66	9,916	S. W.	5.7	1.0	3.3
July	97.6	17.3	51.5	56.2	24.4	42.8	23.389	22.971	23.254	60	7,415	S. E.	7.7	1.5	4.3
August	80.0	13.4	53.8	53.2	14.7	41.4	23.377	23.105	23.248	40	7,890	S.	8.5	2.3	5.0
September	96.0	18.2	52.3	44.2	10.3	30.3	23.356	22.748	23.106	*	*	S. W.	11.0	0.5	5.6
October	93.2	15.6	48.4	37.2	1.0	20.2	23.355	22.728	23.061	60	10,729	S.	10.5	2.5	6.0
November	100.0	20.7	47.8	32.0	-10.0	14.4	23.317	22.746	23.118	56	10,326	S. W.	8.4	1.9	5.0
December	100.0	21.6	65.8	25.5	-23.0	8.5	23.341	22.575	23.018	50	8,132	S. W.	9.0	0.5	4.8
Summary			677.0			270.4			276.643						53.1
Mean			56.4			22.5			23.054						4.4

* Instrument broken during part of September.

Table V. PRECIPITATION. 1894

PLACE.	January	February	March	April	May	June	July	August	September	October	November	December	Total
Laramie	0.03	0.10	0.29	1.51	0.42	0.64	1.41	1.26	1.60	0.09	0.05	0.23	7.63
Lander	0.16	1.10	4.14	1.07	0	0.20	0.97	0.41	2.29	0.03	0.32	0.03	10.72
Saratoga........	0.60	0.90	2.30	1.87	0.30	0.92	1.96	0.80	1.43	0.25	0.40	1.00	12.73
Sheridan........	0.70	0.72	3.15	1.50	0.64	2.44	1.28	0.11	0.95	Trace	0.80	0.20	12.49
Sundance	1.10	0.75	1.50	0.82	3.18	4.16	2.01	0.37	0.91	2.85	0.98	1.36	19.99
Wheatland......	0.50	0.30	1.08	0.46	•	2.17	2.02	0	0.70	0.70	0.70	1.50	10.13
Cheyenne.......	0.20	0.72	0.93	1.64	1.24	0.64	3.25	2.17	1.23	*	*	•	
Bates Park (Freeland)	*	•	4.35	2.10	0.80	1.45	0.60	0.90	1.80	0.55	0.30	0.25	
Inyan Kara	*	•	1.80	0.71	2.52	5.01	2.78	0.30	*	*	0	0.12	
Hat Creek	0.10	0.32	0.32	1.10	1.22	2.90	4.07	1.18	0.70	0.15	0.30	0.90	13.26
Sybille..........	*	1.28	1.35	2.80	1.91	0.84	1.65	2.92	1.14	0.45	1.36	0.58	
Trelona.........	*	0.19	1.72	*	0.35	*	*	*	*	*	•	*	
Dobin Springs ..	†	†	†	†	†	0.49	2.01	0.33	2.43	0.52	0.70	0.55	
Little Horse Cr'k	•	•	0.48	3.28	0.97	0.72	3.02	1.05	0.86	0.03	0.60	0.18	

* These months not reported. † Commenced observations in June.

GENERAL SUMMARY.

Highest Temperature—Laramie, 87.6, July 11; Lander, 94, July 10; Saratoga, 88, July 10; Sheridan, 96, August 27; Sundance, 94, July 30; Wheatland, 99, July 11.

Lowest Temperature—Laramie, —27, December 28; Lander, —24, February 20; Saratoga, —29, December 27; Sheridan, —36, January 24; Sundance, —28, January 23; Wheatland, —22, January 26.

Highest Monthly Range of Temperature—Laramie, 30, August; Lander, 35.9, August; Saratoga, 42.8, October; Sheridan, 38.9, August; Sundance, 30.5, August; Wheatland, 37.8, September.

Lowest Monthly Range of Temperature—Laramie, 19.9, January; Lander, 21.8, March; Saratoga, 20.1, March; Sheridan, 24.5, March; Sundance, 18.9, January; Wheatland, 22.8, March.

Highest Annual Mean Temperature; 43.4, Lander.

Lowest Annual Mean Temperature; 39.9, Laramie.

Average Mean Temperature for the following five Experiment Farms—Laramie, Lander, Saratoga, Sheridan

and Sundance; 41.7. The observations at Wheatland were interrupted on account of broken instrument.

Greatest Annual Precipitation—19.99 inches at Sundance.

Lowest Annual Precipitation—7.63 inches at Laramie.

Average Precipitation in 1894 for the places furnishing complete records as given in the tables, 12.42 inches.

Killing Frost at Saratoga June 14.

Light Frost at Laramie May 24 and 25.

Hail and Snow at Sheridan April 18.

Other Observations at Laramie.

Highest Terrestrial Radiation—11.0, September 27.

Lowest Terrestrial Radiation—0.0, April 12 and April 30.

Lowest Relative Humidity—10.6, June 26.

Mean Relative Humidity for the year, 56.4.

Highest Dew-Point—56.2, July 3.

Lowest Dew-Point—23.0, December 28.

Mean Dew-Point for the year—22.5.

Greatest Monthly Evaporation—7.492 inches.

Total Evaporation for six months from April 26 to October 27—37.166 inches.

Highest Barometer—23.389, July 1.

Lowest Barometer—22.531, January 3.

Mean Barometer for the year—23.054.

Prevailing direction of the wind—South-west.

Greatest Velocity of Wind—56 miles per hour, April 15, June 6.

Greatest Number of Miles traveled in one month—12,265 miles, March.

Greatest Number of Miles in one day—918, June 5.

The Anemometer being out of order during a part of September, we would refer you to Table No. 5, for other data concerning the wind.

The University

UNIVERSITY OF WYOMING.

Agricultural College Department.

Wyoming Experiment Station,

LARAMIE, WYOMING.

BULLETIN NO. 24.

AUGUST, 1895.

WATER ANALYSES.

BY THE CHEMIST.

Bulletins will be sent free upon request. Address: Director Experiment Station, Laramie, Wyo.

Wyoming Agricultural Experiment Station.

UNIVERSITY OF WYOMING.

PRESIDENT OF THE UNIVERSITY OF WYOMING.

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Cost and Profit of Growing Wheat.

B. C. BUFFUM.

Excepting in two or three localities sufficient wheat is not yet being grown in Wyoming to supply the home market. This is not due to any unfavorable conditions of soil or climate, but may be attributed to lack of agricultural development. Three years ago the Experiment Station took up the subject of wheat growing and instituted experiments to be carried out upon each of the Experiment Farms to determine the place this important product would occupy as a general farm crop in this State.

Naturally the first question in any farming operation is, or should be, will it pay? Many have expressed the opinion that wheat would not pay in this State, as, owing to the extra expense of irrigation, we could not compete with such large wheat-growing States as the Dakotas and Minnesota. Such an opinion, however, is fallacious, as there are several points of advantage in an irrigated crop, any one of which will give a return more than sufficient to meet the comparatively small expense attached to watering the land. The advantages of raising grain under irrigation may be summed up briefly as follows:

ly at high altitudes in the State, when in connection with rye, or other small grain, they will take the place of corn for fattening stock. As our population increases the information here given is in demand, and will directly benefit many who raise garden vegetables for their own tables.

There is an almost endless variety of peas, but probably the larger number of the standard sorts are given in Table I. All these have been grown upon the Laramie Farm for two or more seasons.* In 1894 their growth was not interrupted or retarded by any severe frosts, hail or other unusual climatic conditions. This season, however, has not been so favorable, and any variety which did well the past summer would give good returns under any ordinary conditions of climate likely to occur upon the Laramie Plains. All the varieties were planted April 19th and 20th, seed at the rate of 109 pounds per acre being used. The soil was dry, but all germinated from April 24th to 27th, and came up May 5th to 10th. The only cultivation was hoeing once on June 26th. They were irrigated on June 21st, July 9th, and August 21st and 22nd.

On June 17th an unusually severe frost injured all varieties more or less. In some from eight per cent. to twenty per cent. of the young plants were killed. In Table II these varieties are marked tender. Those showing no effects excepting that a few leaves were frosted are marked hardy, while those which were slow in recovering, still showing the injurious effects ten days after the frost, are marked half hardy. This frost and the cold weather

*Results with peas in 1894 were published in Bulletin No. 22, pp. 73 and 74.

caused the same varieties to be from one to three weeks later in reaching edible maturity than in 1894. Light hailstorms on July 17th and 22nd and August 8th left scars upon the pods which would injure their sale in the market, but they were not otherwise injured.

The same variety is sometimes given different names by different seedsmen. Among the kinds grown those which appear to be the same are as follows:

Blue Imperial Dwarf and Pride of the Market.

Cleaveland's Rural New Yorker, First and Best, Lee's Earliest and Extra Early Daniel O'Rourke closely resemble each other, the greatest variation being in their yields. Midsummer and Prince of Wales seem to be the same. Sterling and Alaska are much alike.

TABLE I.—None of the vines were staked up or trellised. The length of vines was determined, at the time ready for market, by straightening them out and measuring from the ground to the top leaf. The number of days in bearing is from the date ready for market to the time of last picking.

To determine the yield the rows were divided into two parts, leaving one to ripen seed and picking the other part as often as sufficient peas were ready. The weight of a gallon of each variety was carefully taken, and the amount of shelled peas produced by this gallon weighed. The weight of a gallon of peas in the pod varied from two pounds eleven ounces in Melting Sugar to three pounds nine ounces in Extra Early Premium Gem, the average being about three and one-fourth pounds. In varieties with medium sized pods the weight of a gallon was about 2½ per cent. less at the first picking than at the later pickings when the pods were better filled.

The weight of shelled peas from a gallon varied from seven and one-half ounces in Melting Sugar to one pound and eleven ounces in Lee's Earliest, the average being about twenty-two ounces. The shelled peas weighed twenty-one ounces per measured quart.

The number of days it took to mature is from the date the peas came up till they were ready for market.

The last column in Table I gives the value per acre of green peas at the local market wholesale price, which was 3¾ cents per pound. This shows that the better yielding sorts would be a very profitable crop where the market would warrant growing large areas, as the expense of growing them is comparatively small.

TABLE II.—The varieties are arranged first in reference to earliness, reconciling the results of 1894 and 1895 as nearly as possible, and secondly as to their yields, the earliest variety and heaviest yielder being put first in each case. From the column headed condition at time of frost information may be obtained in regard to those varieties which will be likely to ripen seed in a short season. The importance of the last column, headed hardiness, depends upon whether heavy frosts occur late in the spring after the peas are up.

TABLE I. GARDEN PEAS. 1895

Number	Variety.	First Blossoms	In Full Bloom	Ready for Market	Length of Vine, inches	Length of Pod, inches	Number of Days Maturing	Number of Days in Bearing	Yield per Acre of Green Peas in Pod		Yield per Acre of Green Peas, Shelled		Yield per Acre of Ripe Peas, pounds	Value per Acre of Green Peas
									Gallons	Pounds	Gallons	Pounds		
1	Admiral	July 8	July 22	Aug. 1	33	2.7	86	27	2,875	9,344	753	3,953	2,310	$350.40
2	Alaska	June 26	July 2	July 24	31	2.2	80	36	2,653	9,119	600	3,150	3,506	341.96
3	American Wonder	July 2		Aug. 1	17	3.0	86	29	564	1,869	148	775	516	70.09
4	Black Eyed Marrowfat	July 11	Aug. 1	Aug. 8	42	3.5	93	21	2,295	6,886	464	2,438	1,980	258.22
5	Bliss' Abundance	July 11	July 24	Aug. 1	22	3.0	85	17	975	3,168	267	1,401	1,485	118.80
6	Bliss' Everbearing	July 11		Aug. 1	22	3.0	86	17	1,319	4,286	330	1,731	1,403	160.72
7	Blue Imperial Dwarf	July 11		Aug. 8	31	3.0	93	16	2,569	8,348	642	3,372	949	313.05
8	Champion of England	July 8		Aug. 5	34	3.0	90	21	1,733	5,525	474	2,491	2,145	207.19
9	Cleaveland's Rural New Yorker	July 1	July 20	July 29	24	2.5	84	20	886	2,823	221	1,163	1,237	105.86
10	Dwarf Champion	July 11	Aug. 1	Aug. 8	24	3.2	93	16	1,944	6,317	532	2,794	1,155	236.89
11	Dwarf Wrinkled (Edible Pod)	July 11	July 29	Aug. 12	26	2.5	97	14	2,979	10,054	851	4,468	2,227	377.02
12	Echo	July 16		Aug. 8	29	3.7	93	16	867	2,600	227	1,192	577	97.50
13	Extra Early Daniel O'Rourke	July 1	July 16	Aug. 1	30	2.0	86	43	1,865	6,297	444	2,331	1,650	236.14
14	Extra Early Premium Gem	July 11		Aug. 1	16	2.5	86	43	650	2,316	193	1,016	247	86.85
15	Fill Basket	July 8		Aug. 8	26	3.5	94	35	3,146	9,831	824	4,326	1,980	368.66
16	First and Best	June 26	July 16	Aug. 1	26	2.0	87	43	986	3,453	293	1,541	722	129.49
17	Forty Fold	July 8		Aug. 5	42	2.8	90	38	2,162	7,028	515	2,702	1,815	263.56
18	Horsford's Market Garden	July 16		Aug. 5	22	3.0	90	38	1,408	4,489	352	1,848	495	168.34
19	Land's Marrow *	July 8		Aug. 8	40	2.7	93	35	1,313	4,022	428	1,723	412	150.82

*Probably Sander's Marrow.

TABLE I.—Concluded. GARDEN PEAS. 1895

Number	VARIETY.	First Blossoms	In Full Bloom	Ready for Market	Length of Vine, inches	Length of Pod, inches	Number of Days Maturing	Number of Days in Bearing	Yield per Acre of Green Peas in Pod: Gallons	Yield per Acre of Green Peas in Pod: Pounds	Yield per Acre of Green Peas, Shelled: Gallons	Yield per Acre of Green Peas, Shelled: Pounds	Yield per Acre of Ripe Peas, pounds	Value per Acre of Green Peas
20	Lee's Earliest	July 2	July 16	Aug. 1	28	2.2	85	21	584	1.970	188	985	1,072	$ 73.87
21	McLean's Advancer	July 16		Aug. 8	18	2.7	90	11	431	1.483	118	619	247	55.61
22	McLean's Little Gem	July 16		Aug. 8	24		91	11	264	975	85	445	62	36.56
23	Melting Sugar (Edible Pod)	July 8	July 16	Aug. 1	38	3.8	88	27	2,116	5.687	189	992	577	213 26
24	Midsummer	July 16		Aug. 8	30	3.2	95	20	1,495	4.672	356	1,869	247	175.20
25	Pride of the Market	July 11		Aug. 2	24	3.5	85	27	2,925	9,689	801	4,205	949	363.34
26	Prince of Wales	July 16	Aug. 1	Aug. 8	30	3.2	92	28	1,480	4 631	370	1,942	722	173.66
27	Renown	July 18	Aug. 1	Aug. 16*			100*	12*	325	1.036	66	345	247	38 85
28	Royal Dwarf Marrowfat	July 18	Aug. 1	Aug 11*		3.2	96*	17	1,219	3.961	319	1,676	557	148 54
29	Laxton's Alpha	June 26	July 16	July 24	35	2 5	79	27	1,718	6.337	593	3,114	928	237.64
30	Sterling		July 8	July 29	33	3.2	83	19	3.365	10,095	641	3.365	3,011	378.56
31	Stratagem	July 11		Aug. 5	40	3.8	91	24	1,347	4,042	305	1,599	742	151.57
32	Summit	June 26		July 24	33	2.5	80	23	824	2.783	225	1.184	1,052	104 36
33	Tall Sugar	July 8		Aug. 5	40	2.5	92	32	1,556	5,058	481	2,528	1,567	189 67
34	Telegraph	July 8		Aug. 1	33	3.7	86	29	1,219	3.961	247	1,295	392	148.54
35	Telephone	July 8		Aug. 1	39	3.0	86	29	2,161	7 292	592	3.106	1,176	273 45
36	Tom Thumb	July 1		Aug. 1	24	2.5	87	15	645	2,580	230	1.209	186	96.75
37	White Marrowfat	July 16		Aug. 5	36	3.2	90	15	1.514	4.733	342	1 798	825	177 49
38	Yorkshire Hero	July 8		Aug. 5	19	2 8	90	24	2,700	8,775	803	4,219	1,609	329.06

*Estimated.

TABLE II. GARDEN PEAS.

Number	VARIETY.	Ready for Market 1894	Ready for Market 1895	Condition of Vines Sept. 23*	Hardiness
1	Alaska	July 12	July 24	Ripening	Hardy
2	Sterling	Aug. 20	" 29	"	"
3	Admiral		Aug. 1	Green	"
4	Laxton's Alpha	July 28	July 24	Ripening	"
5	Extra Early Daniel O'Rourke	" 12	Aug. 1	Ripe	Half hardy
6	Melting Sugar	" 25	" 1	"	Tender
7	Summit		July 24	"	Half hardy
8	Bliss' Everbearing	July 26	Aug. 1	"	Hardy
9	Telegraph	" 26	" 1	Ripening	Half hardy
10	Bliss' Abundance	" 28	" 1	Ripe	Hardy
11	Tom Thumb	" 12	" 1	"	Tender
12	Extra Early Premium Gem	" 12	" 1	"	"
13	Cleaveland's Rural New Yorker	" 18	July 29	"	Half hardy
14	First and Best		Aug. 1	"	Tender
15	Telephone	Aug. 7	" 1	Ripening	Hardy
16	Lee's Earliest	July 12	" 1	Ripe	Tender
17	Yorkshire Hero	" 26	July 26	Ripening	Half hardy
18	Blue Imperial Dwarf	" 26	Aug. 8	Green	Hardy
19	Forty Fold		" 5	Ripening	"
20	Tall Sugar		" 5	"	"
21	American Wonder		" 1	Ripe	Half hardy
22	White Marrowfat		" 5	Ripening	" "
23	Black Eyed Marrowfat	Aug. 1	" 8	Green	Hardy
24	Champion of England	" 10	" 5	Ripe	"
25	Pride of the Market	" 11	" 2	Ripening	"
26	Stratagem	" 10	" 5	"	"
27	Prince of Wales	" 6	" 8	Green	Tender
28	McLean's Little Gem	" 1	" 8	Ripe	"
29	Fill Basket		" 8	"	Hardy
30	Dwarf Champion		" 8	"	"
31	Land's Marrow		" 8	Green	"
32	Midsummer		" 8	Ripe	Tender
33	Echo		" 8	"	"
34	McLean's Advancer		" 8	"	"
35	Horsford's Market Garden	Aug. 15	" 5	"	Half hardy
36	Dwarf Wrinkled		" 12	"	Hardy
37	Royal Dwarf Marrowfat	Aug. 15	" 11	Ripening	"
38	Renown		" 16	Ripe	Tender

*Time of killing frost

Notes on Varieties which We Recommend for General Planting.

Alaska.—An extra early variety and of this class the hardiest. Plants medium in size, dark green, of dense growth. Green peas smooth, of good quality. Ripe peas light green, smooth.

Sterling.—An early variety and one of the hardiest, with long season, vines of medium size, dark green, of dense thrifty growth. Gave the heaviest yield of any variety grown. Ripe peas, light green, smooth. Very much like Alaska.

Telephone.—Second early, and one of the hardiest and best yielding varieties. Vines large, of thrifty growth. Pods large, well filled. Ripe peas light green, wrinkled. This is of first quality, being one of the most delicious green peas in the list.

Telegraph.—Second early, not so hardy or good a yielder as Telephone, which originated from this variety. Vines of medium size. Pods large and shelled peas of good size. Ripe peas large, light green, wrinkled. Green peas sweet and of fine quality for the table.

Admiral.—A second early variety and one of hardiest and most prolific. Vines large, of thrifty growth. Pods of medium size. Ripe peas large, light colored, wrinkled.

Blue Imperial Dwarf.—Probably same as Pride of the Market. A second early pea, hardy and one of best yielders. Vines of medium size. Pods large. Peas large and of good quality. Ripe peas large, light green, smooth.

Black-eyed Marrowfat.—One of the best late varieties.

Hardy, good yielder. Vines large and thrifty. Pods large. Peas of good size and quality. Ripe peas light colored, large, smooth, with black eye.

Melting Sugar.—Probably the best and most largely grown variety with edible pods. Did not withstand freezing as well as many other varieties, but is a fairly good yielder. Vines large. Pods large, crooked, light colored, stringless, and tender when young. Ripe peas light colored, large and smooth. The young peas cooked pod and all are of fine flavor.